Vol. 5 MAY, 1922 No. 5

# Journal
of the
# American Ceramic Society
## Ceramic Abstracts and The Bulletin

*A Monthly Journal devoted to the Arts and Sciences Related to the Silicate Industries*

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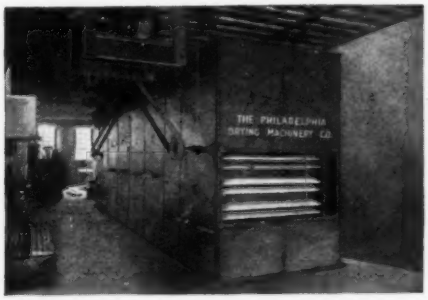


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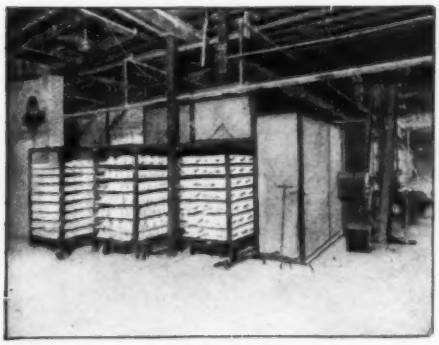

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## IMPORTANT NOTICE
## SUMMER TRIP TO ENGLAND

**See page 7 of Bulletin, this issue**

A cablegram from England announces that seven important potteries will be open to the members of the American Ceramic Society on the occasion of the summer trip to England. These include Wedgwood and Co., Ashworths, Fielding, Josiah Wedgwood and Sons, Minten Hollins, and two other representative plants. This is gratifying news and doubtless many members will now decide to make the trip.

The English Ceramic Society and the Society of Glass Technology are co-operating to secure for us opportunities to visit the best of all sorts of ceramic industries.

Those who wish to make reservations must notify Dr. E. W. Tillotson, Mellon Institute, Pittsburgh, Pa., *at once*.

Read page 7 of Bulletin, this issue, for details.

R. C. PURDY, *Secretary*
Lord Hall, O. S. U.
Columbus, Ohio

# JOURNAL

OF THE

# AMERICAN CERAMIC SOCIETY

**A monthly Journal devoted to the arts and sciences related to the silicate industries.**

**Editor:** ROSS C. PURDY; **Associate Editors:** L. E. BARRINGER, E. W. TILLOTSON, ROY HORNING, R. R. DANIELSON, A. F. GREAVES-WALKER, F. H. RHEAD, H. RIES, R. L. CLARE.

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## ORIGINAL PAPERS

### REDUCTION OF VARIETIES IN MANUFACTURED PRODUCTS[1]


BY E. W. MCCULLOUGH


I appreciate both the pleasure and honor of addressing your organization which in another year will have completed a quarter of a century's activities in behalf of the many lines grouped under the heading "ceramics."

I desire to deal with my subject almost wholly from a commercial economic angle rather than the scientific, although to a very great extent the economies to be accomplished will be gained through the recognition of fundamental engineering principles in establishing standards.

It is common knowledge that in the world's industrial development the production of most of our common commodities has been from very crude beginnings, improving step by step through the acquisition of skill on the part of the operative and in many instances without the recognition of scientific principles except in a very general way. The father transmitted to his sons the knowledge he developed in his labors beginning with the raw materials and ending with the product in its finished state. Perhaps in few lines has this been more true than in the manufacture of various ceramic products.

With the introduction of power machinery, for the first time it was realized that certain laws and principles would have to be recognized in creating new designs and bringing about mass production, but even this

[1] Address delivered by E. W. McCullough, Manager, Fabricated Production Department, U. S. Chamber of Commerce, to the Twenty-fourth Annual Meeting of the American Ceramic Society, St. Louis, Missouri, Feb. 27, 1922.

step did not cause the research necessary to develop a conviction that it would be advisable to go back to first principles and build the manufacture of each commodity on a scientific basis; consequently there is today in the manufacture of many commodities much waste that can be eliminated.

The early wagon-maker with knowledge gained by experience in working woods and metals, built crude but sturdy vehicles, relying wholly on his experience in blacksmithing to determine whether he should use a half-inch round rod for bracing or whether it should be five-eighths or three-quarters. If he erred, it was usually on the side of using more materials, not less, but as materials today have more than doubled in cost in most instances, it becomes necessary to analyze the construction of this man's work and determine how far his material requirements can be reduced and at the same time retain the strength and service required.

With the use of machinery it was realized that the fundamental of low cost production was small variety and large volume and for a time this rule was well adhered to, but with the various changes in marketing conditions and the seeking of trade in more distant territories there grew up a marked tendency to the increase of variety.

One instance in your own lines will suffice to illustrate. The paving brick manufacturers and engineers recently met in coöperation to reduce variety which had grown in that line to the number of sixty-six, and they were able by fully realizing the situation to reduce this number to eleven, thereby casting out fifty-five styles, sizes and kinds.

Secretary Hoover in addressing them preliminary to their action, said:

> The proposal that you are considering is no new idea in American industry, but it comes up in its best form on this occasion because it is inspired by the manufacturers themselves.
>
> I think the engineers, of whom I have long been one, have been united in the feeling that there is a great area of waste in American industry that can find correction only at the hands of the manufacturers and can find it only in a purely voluntary action on their part.
>
> We are, in a broad sense, confronted with a great many economic difficulties—the necessity to maintain a high wage level, the consequent necessity to reduce all processes of manufacture to the lowest possible costs, and under the compulsion of eliminating every possible waste of industry itself. There is one thing that stands out about American industry that comes up daily to the Department, and that is the remarkable efficiency of the individual industry and the very considerable inefficiency of collective industry. If we had the same native efficiency collectively in this country that we have individually, we would have no difficulty in maintaining our own in foreign or international commerce, of maintaining the high wage levels and the high standards of living, and it is only by virtue of some prompt action that we can hope to secure some fundamental readjustments that the country must have.

There has been a great lack of coöperation and coördination between the production and sales departments of many manufacturing organizations and perhaps a lack of backbone in the management in permitting either the

manufacturing department or the sales department to predominate in determining the lines which should be made or the changes and variations to be made in standard lines which had been adopted.

The slogan "We make what our trade calls for" is equally as fruitful of trouble as the slogan of a famous retailer "The customer is always right." I would cast no reflection on those who watch carefully the trend of their customers' thought and seek to provide what will best meet their real needs, for such vigilance is most certain to be rewarded by continued dealings and confidence on the part of the customers, but this is quite different than chasing whims and fancies, whether it be those of the consumer or some division of the distributing agency which seeks continually to present something new and novel, whether or not there is any merit in it. Perhaps there is no agency which has been more responsible for the large and wasteful variety found in many manufactured lines today than the over-ambitious sales organization which can see nothing but volume of orders and takes no thought of whether or not what they take orders for will net a profit or a loss.

One large concern in the iron and steel lines discovered that their catalog was rapidly growing, but out of all proportion with their profits, and decided to analyze their stock to discover just what lines were most greatly in demand and profitable. Their catalog at that time contained 17,000 items and the result of their inquiry revealed the fact that but 614 lines were being produced in profitable volume. The remainder was made up largely of special patterns either to imitate those of their competitors or with the hope that they would develop into larger volume. That concern is today employing part of the time of its sales forces in having their customers realize the advantages of standardization and the reduction of variety to the end that there may be not only dollar and cents economy but great improvement in service.

In the investigations which my department of the United States Chamber of Commerce has been making for something over a year, we have found that excess variety in some lines obtains to such an extent that factories have almost been reduced to the level of hand shops, in other words, the runs are so short and the machine changes so frequently and the demoralization of labor is so great that costs and overhead have mounted to such a height that there is not a wide difference between the costs of the factory and the custom-made products referred to.

In the years which preceded the war we drifted more or less unconsciously into this matter of great variety through, perhaps, the great stress which was laid on the individuality of products by advertising. There was a very general tendency in certain kinds of advertising to emphasize particular brands not only as to the merits of manufacture, but by the assurance that they were designed to meet individual needs more nearly than that

of their competitors. There was unquestionably a tendency to try to convince the consumer that they could meet his every need in the variety they offered him to select from.

Perhaps this situation was most fully realized when the Conservation Division of the War Industries Board took hold to save money, materials and men when we entered the world's conflict. Their first analysis of the situation showed how badly overdone this matter of variety was particularly when they looked into many lines of personal wear. They found, for instance, in the matter of shoes that there were as many as seven shades of tan colored leather. Their judgment was that one light shade and one dark shade was sufficient. They went into clothing lines, rubber coats and numberless other articles and made equally drastic reductions.

We lived through the war, suffering no inconvenience whatsoever on this reduced variety, but just as soon as the Government's hand was lifted from the enforcement of these restrictions, the old-time clamor for more variety returned and many of the lines which benefited greatly by enforced reduction are now suffering as they did before from excessive variety.

At a recent meeting held in the Department of Commerce at which prominent architects, builders and engineers were present, the question of reducing varieties in building trade commodities was the principal subject of consideration. It had been claimed that the classes to which these men belonged had been largely responsible for the wasteful varieties which obtain in building commodities at this time. Undoubtedly they contributed as did all other elements to the excess, but they were found to have very great willingness at this time to lend their assistance and bring about reduction at the earliest possible moment. Suitable resolutions setting forth their attitude were passed and the following items were named which should receive the earliest attention: millwork, plumbing, heating, interior wall construction, hardware, lighting fixtures and clay products, the latter comprehending all ceramic productions used in building construction.

Some of these lines have already organized and have made considerable progress and it is expected that because of the attention which will be given them, practically all others will sooner or later fall in line. We are all aware of the difficult housing situation throughout the country and that building has been held up for several years to the detriment of our people in many ways, and it is high time that something practical should be done to make resumption in building possible. It is believed that with the economies which can be worked out in building material lines, a very considerable reduction in cost will most certainly follow.

At the risk of rambling a bit, I desire to cite you an instance in the farm implement line where by reason of following a program of standardization and elimination one large concern this year was able to reduce its inventories at the factory and in various portions of the country 30 per cent.

and their normal inventory being nearly $15,000,000, their saving in capital alone can be appreciated, but the president of the concern makes the further significant statement that they are now carrying a better assorted stock than ever before and are in position to serve their dealers and the farmers more efficiently than at any time in their career. In that line the eliminations numbered 955 and types retained 137.

Here are some of the gains to the manufacturer:

1. Less capital tied up in (*a*) Raw materials, (*b*) Semi-finished stock, (*c*) Finished stock, (*d*) Jigs, dies, templates and special machinery, (*e*) Storage floor space, (*f*) Repair parts.

2. More economical manufacture through (*a*) Larger units of production; reduced number of manufacturing units, (*b*) Longer runs, less frequent change, (*c*) Higher rates of individual production, (*d*) Accurate and proper estimating for production, (*e*) More effective stock control, (*f*) Better and more simplified inspection, (*g*) Less idle equipment; reduced amount of equipment, (*h*) Greater ease in securing raw materials, and conserving raw products, (*i*) Cheaper handling of stock, (*j*) Reduced clerical overhead, (*k*) Simplified and more accurate costing system, (*l*) Elimination of waste in experimentation and design, (*m*) Standardized material inventories.

3. More efficient labor due to (*a*) Making training of employees more simple, (*b*) Better earnings, through increased individual production made possible by longer runs, (*c*) Happier and more contented workmen, (*d*) Skill increased by repetitive process, (*e*) Less labor idle from preventable causes, (*f*) More permanent employment as contrasted to present seasonal employment.

Points of economic and industrial significance:

1. It enables buyer and seller to speak the same language, and makes it possible to compel competitive sellers to do likewise.

2. Better quality of product through ability of manufacturer to concentrate on better design and through the reduction of manufacturing expense.

3. It lowers unit cost to the public by making mass production possible, as has been so strikingly shown in the unification of incandescent lamps and automobiles.

4. By simplifying the carrying of stocks it makes deliveries quicker and prices lower.

5. It decreases litigation and other factors tending to disorganize industry, the burden of which ultimately falls upon the public.

6. It eliminates indecision both in production and utilization—a prolific cause of inefficiency and waste.

7. It stabilizes production and employment, by broadening the possible market, and by making it safe for the manufacturer to accumulate stock during periods of slack orders to an extent which would not be safe with an unstandardized product.

8. By focusing on essentials, it decreases selling expense: one of the serious problems of our economic system.

9. By concentrating on fewer lines, it enables more thought and energy to be put into designs, so that they will be more efficient and economical.

As a result of the activities of the Chamber in coöperation with the Department of Commerce several hundred commodity lines are today studying this subject of simplification of variety and standardization, and many of them are making notable progress, in fact in several instances the results are comparable with what was done in the paving brick case. Concerns manufacturing not only for domestic trade, but for trade abroad, have become aware that the Germans began immediately following the close of the war to study dimensional standardization with reference to practically all their commodities, and in this study finally reached the point where they appreciated the value of eliminations and have been pursuing that angle as well.

This country is very largely responsible for what is commonly known as "mass production," in fact it is because of our ability to produce good goods in large quantities at low cost that we have been able to invade the markets of the world, many of which change very slowly, and we should not have their trade today if it were not for our ability to produce satisfactory goods at the right prices, but we believe there is real danger in what we have pointed out, that as we increase varieties we can not get mass production in the broadest sense, and we shall lose much of our efficiency unless a careful study is made in every line to meet the needs of the consumer and to disregard to a reasonable extent mere whims and fancies.

Some misunderstanding and perhaps confusion has occurred as to what is meant by standardization when closely coupled with the terms "eliminations" or "simplification" of variety. It should, however, be clear that no attempt is being made to standardize or reduce commodities to a common pattern—they will continue to embody the distinctive design and form of the producer but will avoid needless duplications and the making of near sizes which make for waste. There will also be standardization of non-competitive parts such as stove legs and lids, wheel diameters, and such other parts as may be made interchangeable to advantage.

Just a word in closing, to suggest that all the efforts which are being made to have the evil we have referred to recognized are purely of a voluntary character. The control over variety in manufactured products ceased with the close of the war, and whatever may be done to clean up the various lines and place them in better condition for economical production, sale and distribution must be wholly by those who produce and distribute them.

Perhaps it may not be amiss for me to say a word as to the connection of the Chamber of Commerce of the United States through its Fabricated Production Department with these activities. The Chamber in its nearly

ten years of service to business, about three years ago felt that it might increase this service through the creation of eight new departments to deal with the more intimate problems of commerce and industry and to that end created departments to deal with such problems as that of finance, raw materials, fabricated production, insurance, foreign commerce, civic development, transportation and communication, and domestic distribution. These departments are all in charge of experienced men and staffs of employees devoting their entire time to dealing in a non-partisan way with such common problems as invite attention.

It is our desire to so coöperate with your own great organization as to make available to you this additional service developed in fields somewhat broader and more general than your own but none the less valuable.

# BERYL AS A CONSTITUENT IN HIGH TENSION INSULATOR PORCELAIN

By Robert Twells, Jr.

ABSTRACT

**Beryl as a Constituent in High Tension Insulator Porcelain.**—Two series, one of 9 bodies and one of 6, were prepared, in which flint and feldspar were partially replaced, weight for weight, by beryl. Bars and discs were fired to cone $8^3/_4$, to 10, or to $10^3/_4$ and tested for *shrinkage, transverse strength, impact strength, heat resistance, absorption of moisture,* and *dye penetration.* The results show that introduced in proper proportions beryl increases the transverse strength, impact strength, heat resistance and dielectric strength. The best results are obtained with the following limits of composition:

| | |
|---|---|
| Clay | 48.54% |
| Feldspar | 13.30 to 23.98% |
| Flint | 0.0 to 5.83% |
| Beryl | 21.65 to 37.63% |


## Previous Investigations

Bleininger and Riddle[1] have reported that beryl used as a flux gives porcelains having high electrical resistance, high Te[2] values and low thermal expansion. The three bodies reported had the relatively low firing temperature of cones 11 and 12. Aside from this article there seems to be little published information in regard to the use of beryl in porcelain. At the General Electric Company, however, several investigators have done work on this subject.

Treischel[3] reported that beryl when substituted for flint gave a body of high dielectric strength, high resistance to temperature changes, high mechanical strength and low absorption. Leibson[4] covered a series replacing feldspar and flint partially with beryl. He reported satisfactory results similar to Treischel's.

Twells and Lin[5] made up three bodies containing calcined beryl and tested them in comparison with a standard triaxial porcelain. Their results at cone $9^3/_4$ can be summarized as follows:

(1) The standard porcelain was non-porous. It had high mechanical strength, fair dielectric strength, fair resistance to temperature changes and good resistance to impact.

[1] A. V. Bleininger and F. H. Riddle, *This Jour.*, **2**, 564 (1919).

[2] Temperature in degrees C at which a cubic centimeter of material still shows a resistance of one megohm.

[3] Chester Treischel, Research Department Report, General Electric Company, May, 1918.

[4] J. S. Leibson, Research Department Report, General Electric Company, November, 1919.

[5] Robert Twells, Jr., and C. C. Lin, Research Department Report, General Electric Company, September, 1920.

(2) When half of the $K_2O$ in the RO of the standard porcelain was replaced by BeO, the $Al_2O_3$ and $SiO_2$ being held constant, the body was not vitrified. As a result, all of its properties were low except the resistance to temperature changes which was very high.

(3) When all the $K_2O$ in the RO of the standard porcelain was replaced by BeO, the $Al_2O_3$ and $SiO_2$ being held constant, the porosity was farther increased. This resulted in greatly lowering all of the properties including the resistance to heat changes.

(4) When the feldspar in the standard porcelain was replaced by beryl on a pound for pound basis, the porosity was even greater than that of the other two beryl bodies. The properties of this body were almost the same as when the $K_2O$ was totally replaced molecularly by BeO, but the color in this case was cream and the resistance to heat changes was better.

The conclusions from the results by these investigators are:

(1) BeO has not nearly the fluxing action of $K_2O$ when used to replace it molecularly in large percentages.

(2) Beryl is not equal to feldspar in fluxing action when used to replace it pound for pound in large percentages.

(3) Beryl is a valuable constituent in a semi-vitreous porcelain which must resist heat changes.

## Present Investigation

### Series I

**Purpose.**—The purpose of this series was to check and extend results of Treischel and of Leibson, replacing the flint and feldspar, pound for pound, with beryl while maintaining a constant clay content.

#### Sources of Raw Materials

Flint, Pennsylvania Pulverizing Co.
Feldspar, Eureka Flint and Spar Co.
Beryl, Foote Mineral Co.

Table I

Composition of the Bodies

| Body number | Per cent clay | Per cent beryl | Per cent feldspar | Per cent flint |
|---|---|---|---|---|
| 1 | 48.54 | ... | 33.98 | 17.48 |
| 2 | 48.54 | 5.83 | 33.98 | 11.65 |
| 3 | 48.54 | 11.63 | 33.98 | 5.83 |
| 4 | 48.54 | 17.48 | 33.98 | ... |
| 5 | 48.54 | 22.48 | 28.98 | ... |
| 6 | 48.54 | 27.48 | 23.98 | ... |
| 7 | 48.54 | 32.48 | 18.98 | ... |
| 8 | 48.54 | 21.65 | 23.98 | 5.83 |
| 9 | 48.54 | 10.83 | 28.98 | 11.65 |

**Preparation and Methods of Testing.**—The corner members of the series, numbers 1, 4 and 7, were weighed out and blunged thoroughly. From these the remainder of the bodies of this series were made up by cross-blending. The preparation and testing of the bodies were performed exactly as has been already described in the *Journal* in an article by Twells and Lin.[6] For the resistance to heat changes the second method described was used.[7]

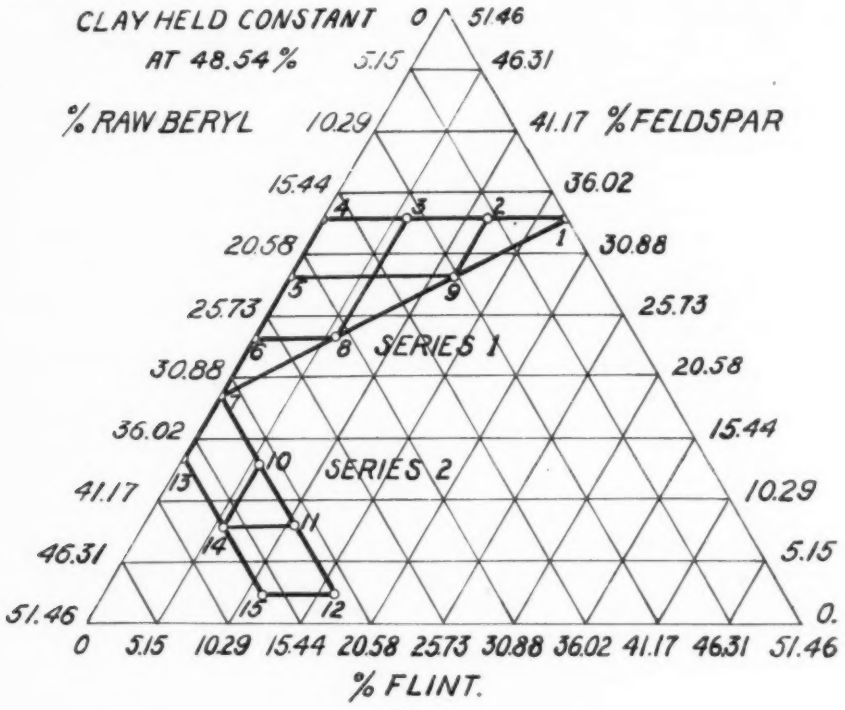


FIG. 1.

**Drying and Firing.**—The test pieces were thoroughly air-dried and then placed in saggers with standard cones. They were fired in a round up and down draft periodic kiln to cone $10^3/_4$ in 51 hours.

TABLE II

SUMMARY OF DATA (CONE $10^3/_4$)

| Body number | SHRINKAGE PER CENT OF WET LENGTH | | | ABSORPTION PER CENT OF DRY WEIGHT | | | DYE TEST | COLOR |
|---|---|---|---|---|---|---|---|---|
| | Drying | Burning | Total | Min. | Max. | Av. | | |
| 1 | 6.1 | 11.3 | 17.4 | 0.07 | 0.07 | 0.07 | NP | White |
| 2 | 5.5 | 10.2 | 15.7 | 0.07 | 0.11 | 0.08 | NP | White |
| 3 | 5.4 | 9.8 | 15.2 | 0.08 | 0.10 | 0.09 | NP | White |
| 4 | 4.9 | 9.0 | 13.9 | 0.07 | 0.11 | 0.09 | NP | White |

[6] Robert Twells, Jr., and C. C. Lin, *This Jour.*, **4**, 195 (1921).

[7] *Ibid.*

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 5 | 5.5 | 9.1 | 14.6 | 0.06 | 0.08 | 0.07 | NP | White |
| 6 | 5.4 | 9.6 | 15.0 | 0.06 | 0.08 | 0.07 | NP | White |
| 7 | 4.9 | 10.9 | 15.8 | 0.06 | 0.07 | 0.07 | NP | White |
| 8 | 6.1 | 10.5 | 16.6 | 0.07 | 0.10 | 0.08 | NP | White |
| 9 | 5.7 | 11.5 | 17.2 | 0.05 | 0.07 | 0.06 | NP | White |

TABLE III

| Body no. | MODULUS OF RUPTURE LBS. PER SQ. IN. | | | RESISTANCE TO IMPACT INCHES OF DROP | | | RESISTANCE TO TEMPERATURE NO. OF HEATS STOOD CHANGES | | |
|---|---|---|---|---|---|---|---|---|---|
| | Min. | Max. | Av. | Min. | Max. | Av. | Min. | Max. | Av. |
| 1 | 4720 | 7940 | 6440 | 14.0 | 38.5 | 25.0 | 8 | 9 | 8.0 |
| 2 | 6690 | 8000 | 7270 | 26.0 | 37.5 | 32.5 | 6 | 10 | 8.5 |
| 3 | 5810 | 8740 | 6880 | 20.0 | 35.0 | 27.5 | 7 | 23 | 14.0 |
| | | | | | | | | Over | Over |
| 4 | 4290 | 7340 | 5770 | 12.0 | 28.0 | 17.0 | 8 | 25 | 14.0 |
| | | | | | | | | Over | Over |
| 5 | 6380 | 7860 | 6940 | 18.5 | 37.0 | 27.5 | 4 | 25 | 14.8 |
| | | | | | | | | Over | Over |
| 6 | 4870 | 7860 | 6450 | 18.5 | 35.0 | 27.5 | 8 | 25 | 20.8 |
| | | | | | | | | Over | Over |
| 7 | 6200 | 8650 | 7110 | 21.0 | 37.0 | 29.5 | 14 | 25 | 22.2 |
| | | | | | | | | Over | Over |
| 8 | 6650 | 9150 | 7890 | 23.5 | 44.0 | 36.0 | 8 | 25 | 19.6 |
| | | | | | | | | Over | Over |
| 9 | 4800 | 7310 | 6300 | 20.0 | 26.5 | 23.5 | 6 | 25 | 12.6 |

## Comments on Results

**Firing Shrinkage.**—The substitution of beryl for flint, with feldspar constant, decreases the burning shrinkage. The substitution of beryl for feldspar, with flint constant, increases the burning shrinkage.

**Absorption.**—All of the bodies are thoroughly vitrified but are not overfired.

**Mechanical Strength.**—The replacement of flint by beryl, with feldspar constant, tends to lower the transverse strength and the resistance to impact. The replacement of feldspar by beryl, with flint constant, tends to raise the transverse strength and the resistance to impact.

**Resistance to Heat Changes.**—The substitution of beryl for either flint or feldspar increases the resistance to temperature changes; this resistance increasing with increasing percentage amounts of beryl.

**Effect of Proportions.**—Properties better than those of the standard porcelain are obtained only with certain proportions of flint, feldspar, and beryl. For example, replacement of flint by beryl in the standard porcelain produces an inferior porcelain; yet if the beryl is at the same time increased at the expense of the feldspar, a very superior porcelain (No. 7) is produced, which contains no flint.

The best body (No. 8) contains a small percentage of flint, and the third best body (No. 2) contains only a small percentage of beryl.

## Present Investigation

### Series II

**Purpose.**—Bleininger and Riddle[8] gave the following formula of a spark plug porcelain maturing at cone 11:

| | |
|---|---|
| Kaolin | 40% |
| Ball clay | 10% |
| Flint | 15% |
| Beryl | 35% |

As this porcelain was much different from those previously tried, it was thought well to cover the area on the triaxial diagram lying between this body and the area previously covered. Preliminary experiments had shown the inadvisability of totally omitting the feldspar in a porcelain to mature between cones 9 and 11. The minimum percentage of feldspar used in this series was 2.46%.

Table IV

Composition of the Bodies

| Body number | Per cent clay | Per cent beryl | Per cent feldspar | Per cent flint |
|---|---|---|---|---|
| 10 | 48.54 | 32.48 | 13.30 | 5.68 |
| 11 | 48.54 | 32.48 | 8.15 | 10.83 |
| 12 | 48.54 | 32.48 | 2.46 | 16.52 |
| 13 | 48.54 | 37.63 | 13.83 | ... |
| 14 | 48.54 | 37.63 | 8.15 | 5.68 |
| 15 | 48.54 | 37.63 | 2.46 | 11.37 |

**Procedure.**—These bodies were made up similarly to series I, by blending the four corner bodies, 7, 13, 12, 15. The method of preparing the test pieces, placing in saggers and firing was the same as before. Temperatures of cones $8^3/_4$ and 10 were obtained. The writer was unable to complete all the tests on this series. This was unfortunate since the results of some important tests are missing.

Table V

Summary of Data

| Body number | Shrinkage per cent of wet length cone $8^3/_4$ | | | Absorption per cent of dry weight | |
|---|---|---|---|---|---|
| | Drying | Burning | Total | cone $8^3/_4$ Av. | cone 10 Av. |
| 1 | 5.3 | 8.2 | 13.5 | 0.02 | 0.01 |
| 7 | 5.0 | 9.5 | 14.5 | 1.11 | 0.03 |
| 10 | 3.7 | 9.3 | 13.0 | 1.68 | 0.02 |
| 11 | 4.0 | 9.2 | 13.2 | 2.74 | 0.26 |
| 12 | 4.0 | 7.2 | 11 2 | 8.75 | 3.54 |
| 13 | 4.8 | 9.2 | 14.0 | 1.85 | 0.04 |
| 14 | 4.8 | 8.7 | 13.5 | 3.53 | 0.69 |
| 15 | 4.7 | 6.3 | 11.0 | 7.83 | 2.65 |

[8] A. V. Bleininger and F. H. Riddle, *This Jour.*, **2**, 564 (1919).

TABLE VI

SUMMARY OF DATA

| Body number | MODULUS OF RUPTURE CONE $8^3/_4$ LBS. PER SQ. IN. Av. | CONE 10 Av. | COLOR |
|---|---|---|---|
| 1 | 7940 | 7860 | White |
| 7 | 7120 | 7150 | White |
| 10 | 7180 | 8760 | White |
| 11 | 5750 | 6310 | White |
| 12 | 4560 | 5040 | White |
| 13 | 6530 | 8180 | White |
| 14 | 6030 | 7600 | White |
| 15 | 7120 | 6060 | White |

## Comment on Results

**Firing Shrinkage.**—In the area covered, the substitution of beryl for either flint or feldspar decreases the burning shrinkage. This is due to decreased vitrification.

**Absorption.**—Cone $8^3/_4$—All the bodies in the area covered are very porous at this temperature. The absorption increases with the increase of either flint or beryl at the expense of the feldspar. Cone 10—Bodies 7, 10 and 13 are vitrified at cone 10. The other bodies of the series are porous at this temperature. The replacement of the feldspar by either flint or beryl increases the absorption but the beryl tends to increase the absorption at a greater rate than the flint except with low feldspar content. In this series a minimum of 13.30% of feldspar was needed for vitrification at cone 10.

**Mechanical Strength.**—The transverse strengths of all the bodies are closely dependent on their degree of vitrification. The transverse strength of the standard body (No. 1) is much increased at cone $8^3/_4$ and cone 10 over what it was in series I at cone $10^3/_4$, although the absorption is practically zero in each case. This tends to confirm what the writer had previously noted that this body had its best mechanical strength at the minimum temperature at which it was vitrified.

Body No. 7 has practically the same transverse strength at the three temperatures tried.

Body No. 13 shows a marked increase in transverse strength over No. 7.

No. 10 is better in transverse strength than No. 13 and it is also better than No. 8, the best one of previous series.

This confirms the results of the previous series, that the replacement, within limits, of feldspar by beryl increases the mechanical strength, and that flint, at least in small percentages, adds to the mechanical strength.

## General Conclusions

**Best Range of Composition.**—Of the bodies tested in both series the best for use at cones 10 to 11 would seem to be bodies 7, 8, 10 and 13. These have the following range of composition:

| | |
|---|---|
| Clay | 48.54% |
| Feldspar | 13.30 to 23.98% |
| Flint | 0.0 to 5.83% |
| Beryl | 21.65 to 37.63% |

To judge only by the results of the transverse strength test, body No. 10 is the best, with No. 13 second. Since, however, all the tests were not completed on these bodies, it is necessary to regard No. 8 as the best all-round body developed. For this reason No. 8 was selected for comparison in the electrical test against the standard body (No. 1).

**Dielectric Strength.**—Test for dielectric strength was made in the manner described by Twells and Lin.[9] The averages of ten trials of each body are as follows:

No. 1, 150 volts per mil.
No. 8, 175 volts per mil.

**Comparison of the Best Beryl Body with the Typical Electrical Porcelain Body.**—A comparison of the results at cone $10^3/_4$ of the tests on the standard body (No. 1) with those on the best beryl body (No. 8) (both being vitrified) shows the value of beryl as a constituent of electrical porcelain. The beryl body (1) has less firing shrinkage, (2) is 22.5% stronger in transverse strength, (3) 44% more resistant to impact, (4) 17% stronger in dielectric strength, and (5) over 145% more resistant to the effect of temperature changes. It is not a difficult matter to improve a porcelain in one or two respects, but the data here given show that the introduction of beryl in certain proportions to the other constituents improves every property tested.[10]

Note: Patents assigned to the General Electric Co. covering the use of crude beryl in porcelain and ceramic insulating compounds are pending.

General Electric Company
Schenectady, N. Y.

[9] Robert Twells, Jr., and C. C. Lin, *This Jour.*, **4**, 195 (1921).
[10] See also A. S. Watts, *Trans. Am. Ceram. Soc.*, **14**, 90–92 (1912).

# ECONOMIC HANDLING OF MATERIALS IN PORCELAIN MANUFACTURE[1]

By A. P. Ball

It has long been recognized in the metal working industries that one of the most promising opportunities for effecting savings lies in mechanical methods of moving materials. Efficiently planned and equipped steel mills, automobile plants and the like have reduced to the minimum the manual handling of materials.

It appears to the writer that at least until very recently the ceramic industries have overlooked the advantages to be secured from efficient handling of materials, possibly because the establishment of these industries so far antedated the metal working industries which have so largely been responsible for the development of mechanical conveying systems.

Comparatively recent developments in ceramic engineering, such as tunnel kilns and continuous driers have, of course, incorporated the latest practice in mechanical movement of materials, but little has yet been done to apply these principles to methods and processes long established in the industry. It might therefore be of interest to outline the manner in which modern practice in handling materials in metal working industries was applied to a dry process electrical porcelain plant. The processes of manufacture used in this plant do not differ essentially from those in general use today in most plants manufacturing similar material. The savings which have been effected in operating this plant are due almost wholly to more efficient handling of materials and not due to changes in existing processes. The installation of a tunnel kiln, tunnel drier and other modern equipment would have made much the same saving in handling material but at a cost far greater. This large investment was not considered justifiable considering the age and condition of the buildings and equipment.

This porcelain plant, located at Peru, Indiana, was purchased shortly after the armistice to insure an adequate supply of electrical porcelain for the manufacture of switches at the company's main plant at Detroit, Michigan. The Works Engineering Department of this latter plant, familiar with modern material handling practice in metal working plants, was struck at once with the great possibilities of handling such bulky and heavy material mechanically. A study of other porcelain plants showed that little or nothing had been done along this line, and furthermore, with a few exceptions, all custom and tradition strongly opposed any change in this direction. The handling of clays by means of bucket conveyors was in occasional use, but the method of loading kilns manually, each man carrying a sagger into the kiln on his head, was virtually universal and it was declared unequivocally that any mechanical method was out of the

[1] Read before White Wares Division, St. Louis meeting, Feb. 28, 1922.

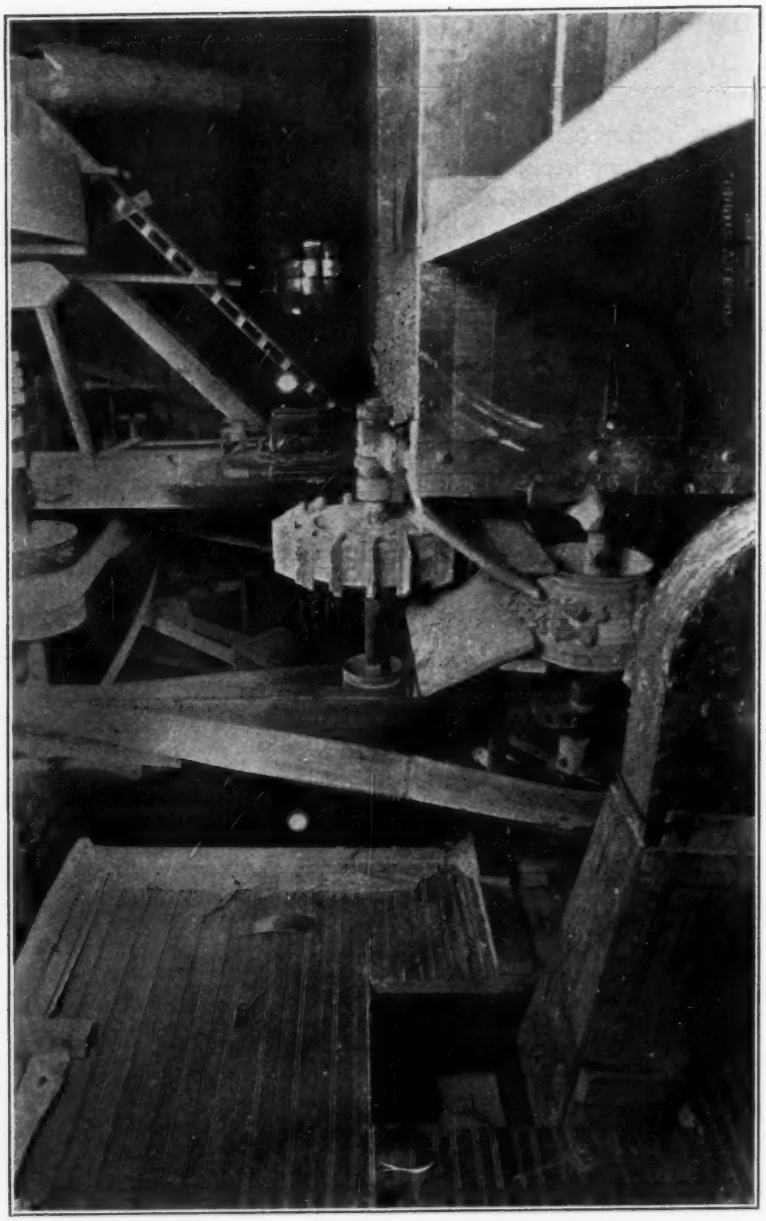

FIG. 1.—Tempering bins with belt conveyor for feeding dust mill. The crushed filter cakes are elevated by the inclined conveyor in the background to an overhead hopper from which the sheet metal pipe directs the crushed clay into the proper bin.

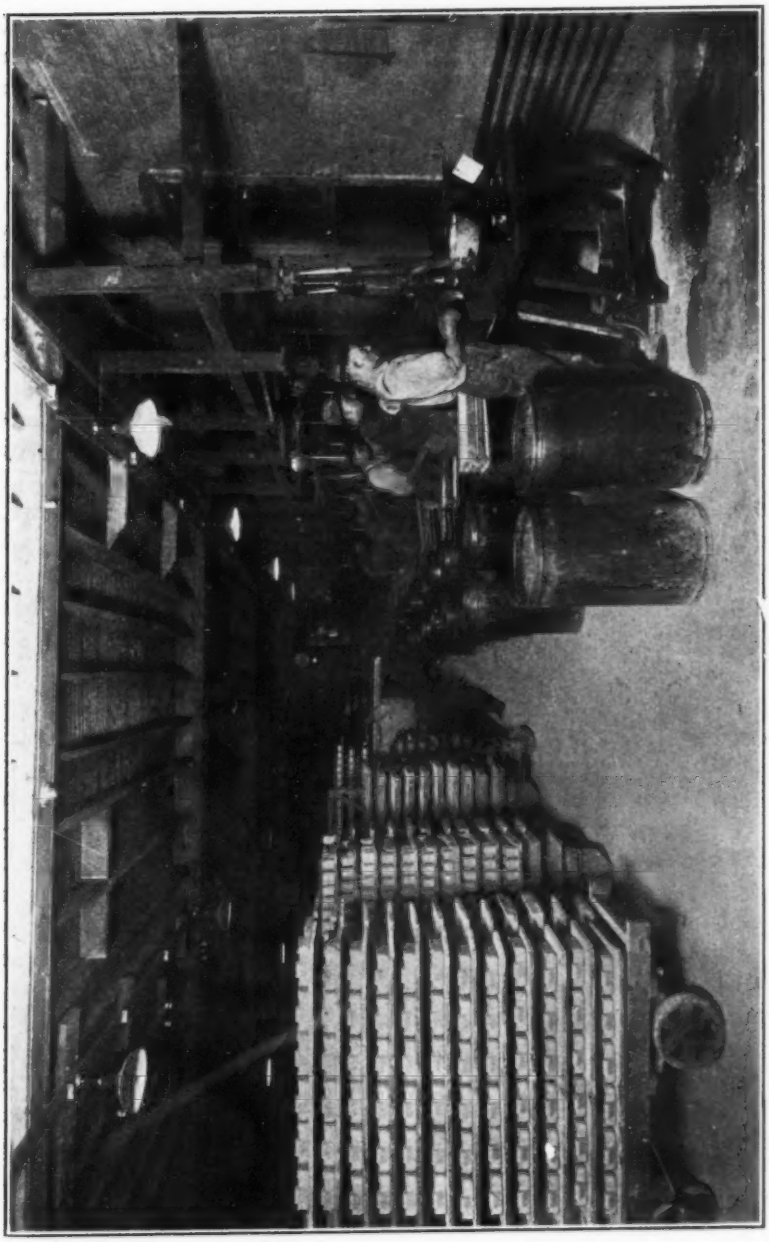

FIG. 2.—Scene in the Pressing Department. Dust is supplied to each operator in steel barrels; boards of pressed ware are loaded onto racks behind the operator. These racks are then moved to the drying room by means of a lift truck.

question. The methods devised for unloading cars of clay by portable bucket conveyors and loading blungers in a similar manner, not being novel, will not be described in detail. The other methods developed in our Peru Plant differed, so far as we can learn, from those in general use, hence will be described.

### Use of Lift Trucks

One of the principal means of moving materials quickly and cheaply, and accepted generally in other lines of manufacture, is the lift truck. Skids were therefore made and used throughout the plant for storing all kinds of material except the raw clay. Frames were made to fit these skids for storing bulky material. These frames were 12″ wide and locked to the skid and to each other so that a container could be built up to any desired height. For dry pressed ware, which was delivered from the press and placed on boards, racks were secured to skids. These racks were made with two uprights carrying 10 horizontal supports made of $^3/_4$″ pipe on each side, affording room on each rack for 20 boards of ware. For the filter cakes a similar rack was made. Any racks or skids could be easily moved by one man by means of the lift truck. A total of about 600 skids and racks are conveniently handled in this plant by eight lift trucks. These various types of skids, skid frames and racks are shown in several of the accompanying illustrations.

### From Filter Press to Pressing Department

Filter cakes as removed from the press are spread out flat on a rack carrying 20 removable boards. As fast as a rack is filled it is moved into a dry room. Formerly this dry room was equipped with stationary racks and the filter cakes were carried in and carried out, one board at a time. The new method eliminates not only carrying manually, but reduces in the proportion of about 1 to 20 the time a man has to be in the hot atmosphere of the dry room and also the time the door must be open, with the consequent drop in temperature. After drying, the rack of filter cakes is moved out to a crusher into which the contents of each board are dumped. The crushed material is elevated by a bucket conveyor to an overhead bin from which it is fed to any of three tempering beds where water is added as the bin is filled. From the tempering bins the material is shovelled onto a belt conveyor running across the end of each bin (Fig. 1) which feeds the dust mill. The dust is delivered into steel barrels which are placed on skids and moved to the Pressing Department by means of a lift truck.

### From Press Room to Dryer

In this department one of the 20-board racks is placed behind each press operator with an aisle left between, as shown in Fig. 2. As soon as he

fills a board he slides it into place on the rack. As soon as a rack is filled, the moveman moves it into a dry room and puts in place an empty rack so there is no interruption at any time to the pressing of the ware.

### From Dryer to Sagger

As soon as the rack of ware is dry, it is moved to the cleaning room where it is placed at the end of a cleaning bench to the left of the operator. The operator, usually a girl, lifts a board from the rack to her bench where each piece is cleaned and put back on the board unless it also requires glazing. If it is to be glazed, it is passed on to the right to the next operator who dips it and places it back on the board. The dust is carried away by exhaust hoods set in the benches at each operating position. After glazing the board is placed on an empty rack at the opposite end of the bench. A view in the Cleaning and Glazing Department is shown in Fig. 3. After the rack is full, it is moved to an electric platform elevator which lowers it to the loading dock on the ground floor where the ware is placed in saggers.

### Conveying to Kilns

Just as in cleaning, the rack is placed adjacent to a loading bench, but behind the operator and at the end of the bench is placed a skid of saggers, as shown in Fig. 4. The placer takes one board of ware from the rack and a sagger from the skid and places the ware in the sagger. As soon as the sagger is loaded it is lifted on a belt conveyor running along the end of the bench at the same level on the left of the placer. The conveyor, as hereafter described, delivers this sagger into the center of the kiln which is being loaded at the time. The placer has to exercise care to see that each loaded sagger is placed on the belt conveyor not less than 4 ft. from the next sagger so that they will arrive in the kiln at a uniform rate. This is accomplished by marking the belt every four feet and requiring that one sagger only be placed between any two marks.

### Loading of Kilns

The belt conveyor for loading the kilns presented a rather serious problem. In spite of the prevalent opinion to the contrary, it was easily demonstrated that a straight-away conveyor could be built which would transport saggers loaded with ware in perfect safety. Experiments showed that by spacing the rollers close together, even fairly unstable pieces of ware would ride without tipping over, and that the vibration would not crack the ware or chip adjacent pieces that came in contact. The problem was rather to devise a means for transferring a loaded sagger from the main conveyor to a conveyor traveling at right angles to it and leading into the kiln. This turn had to be made without undue jarring which would

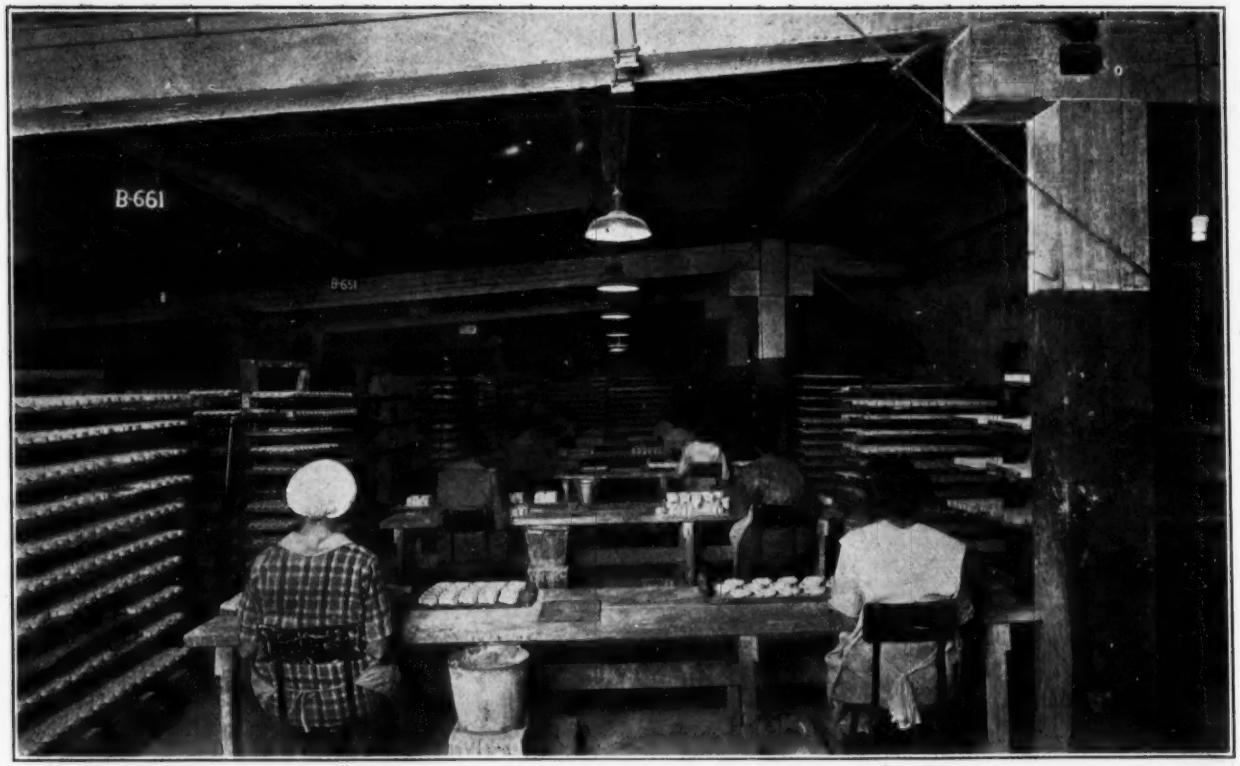


FIG. 3.—View of the Cleaning and Glazing Department. Ware to be cleaned is delivered on racks to the end of each bench and is replaced on the same racks after cleaning. An exhaust system with the opening directly in front of each operator carries off the objectionable dust from the cleaning operation.

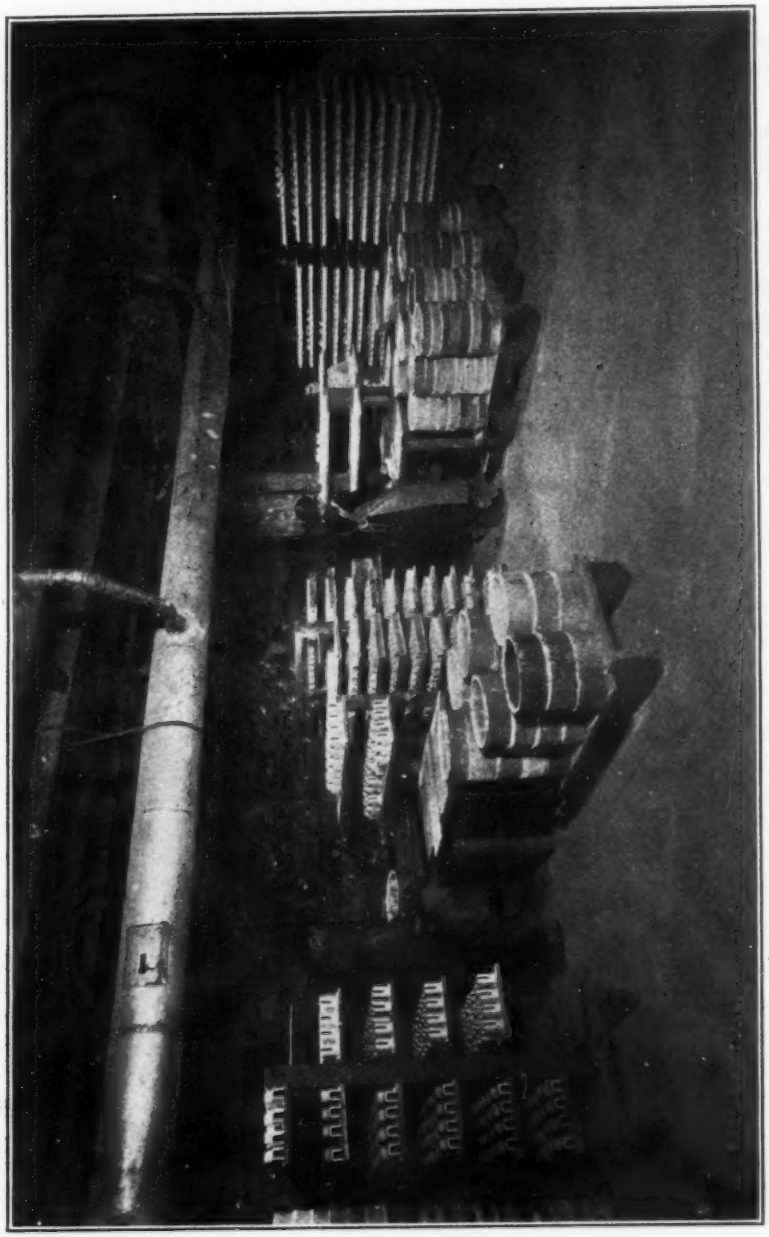

FIG. 4.—Loading dock where ware is placed in saggers. Racks fo ware are moved from the Cleaning Department to the loading dock by means of a lift truck. Saggers are piled on skids and also moved by lift truck. When saggers are filled they are placed on a belt conveyor which delivers them, without further handling, into the kiln being loaded. The man at the left is just placing a sagger on the belt conveyor.

tip over the green pieces or cause them to chip one another. Several manufacturers of conveying apparatus worked on this problem in conjunction with our engineers. None would guarantee the successful operation of the equipment so it was necessary that our engineers take full responsibility for the design finally adopted. Experience since has justified our decision.

The main belt conveyor is 14 in. wide and 180 ft. long, and extends the full length of the Kiln Department past the six kilns. It is placed about 6 ft. above the floor, or 3 ft. above the kiln floor and is located about 8 ft. from the doors of the kilns. Opposite the door of each kiln is a removable section wide enough to permit the insertion at right angles of a short section of belt conveyor driven by a separate motor. This cross conveyor unit carries at one end two rollers which, when clamped into the place where the section of the main conveyor is removed, depresses the main belt sufficiently to provide clearance for the cross belt to fit in place at the same level as the main conveyor belt. Saggers traveling on the main belt strike the section of cross belt traveling at right angles, rotate slowly as the cross belt secures traction and gradually alter their direction until they are moving smoothly at right angles into the kiln. Saggers being transferred from the main conveyor into the kiln on the cross conveyor are shown in Fig. 5. Both conveyors move at the rate of 24 ft. per minute.

The cross conveyor extends well through the kiln door and delivers the saggers onto a steel bench where several can be accumulated if the kiln loader is not ready to stack them. The loader is in telephonic communication with the loading dock so that he can direct the class of ware being placed to suit the position in the kiln where he is working. The cross conveyor is mounted on two large wheels and can readily be transferred from kiln to kiln. It takes two men about $^1/_2$ hour to change the cross conveyor from one kiln to another.

## Unloading of Kilns

The belt conveyor also effects a considerable saving in unloading kilns, the under or return side of the belt being used for this purpose. The fired ware not being so fragile, a portable section of gravity roller conveyor, instead of belt conveyor, is used to extend from the inside of the kiln to the main conveyor. This has a slight pitch and is provided with a curved section at its lower end, made with rollers of gradually reduced diameter so that saggers of fired ware are deposited on the main belt without undue jarring, as shown in Fig. 6. Due to hard particles of wad clay on the bottoms of the saggers and the fact that many saggers are cracked or broken when removed from the bung, it has been found necessary for the kiln unloader to place each sagger of fired ware on a wooden pallet before start-

FIG. 5.—View of the main conveyor showing saggers being loaded and unloaded. The saggers on the upper belt are turned at right angles when they reach the cross conveyor shown in the foreground and are transferred into the kiln. Cross conveyor is portable and can be easily moved from one kiln to another. Saggers of green ware make the turn from the main conveyor belt to the cross conveyor belt without objectionable jarring.

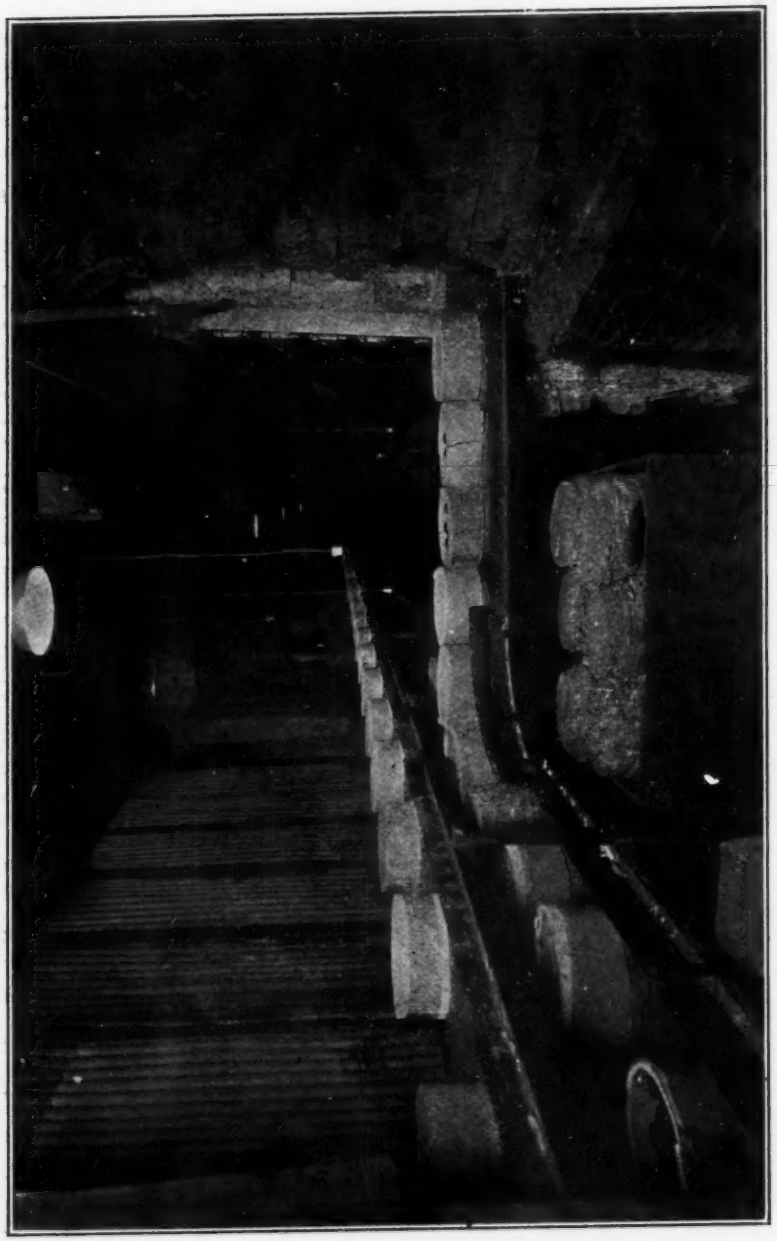

FIG. 6.—Unloading a kiln. The section of portable gravity conveyor carries the saggers of fired ware from the kiln to the main belt conveyor which delivers them into the Inspection Department. The upper belt of the main conveyor shows saggers of green ware passing onto the kiln being loaded.

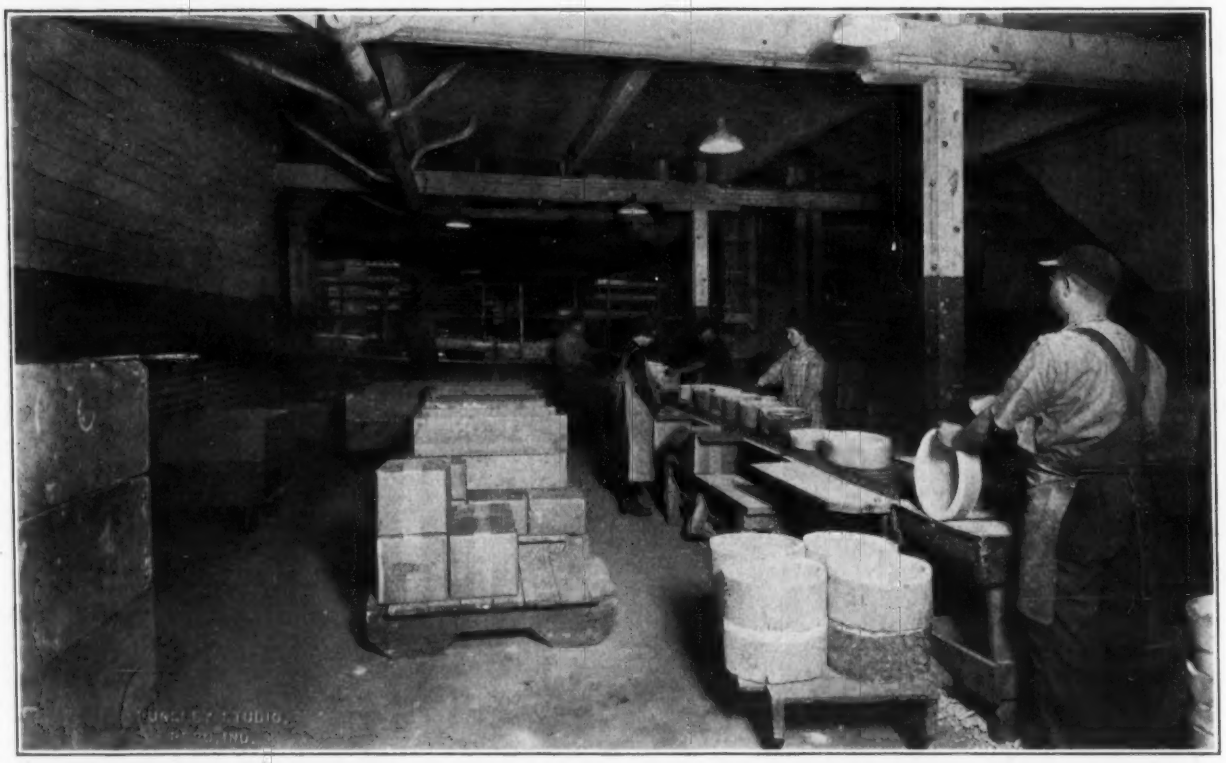

FIG. 7.—View of the Inspection Department. Saggers of fired ware are delivered by the belt conveyors onto gravity conveyor extending through the inspection room. Inspectors on either side of the conveyor remove the pieces, inspect them and place them in skid frames or pack them directly in cartons. The man at the end of the conveyor removes the saggers and pallets and delivers them back to the loading dock and the kilns to be used over again immediately.

ing it along on the gravity rollers as otherwise too great a pitch was required to make certain that it would keep in motion, not to mention the objectionable jarring if it struck the preceding sagger.

## Inspection

Adjacent to the loading dock is located the unloading conveyor and Inspection Department. At this point the unloading belt is depressed by means of a roller and a curved section of gravity conveyor inserted so that the saggers of fired ware are diverted from the main belt and are turned at right angles into the Inspection Department where another similar turn brings them out on the inspection section of the conveyor as shown in Fig. 7. Inspectors stand on either side of this conveyor and remove the ware from the saggers, inspect it and place it in skid frames or cartons near at hand. The empty sagger goes on to the end of the conveyor where it is taken off and piled on skids with others of the same size. The pallet is thrown in a skid frame which when full is taken by means of a lift truck back to the kiln being unloaded. Whenever a skid of saggers is loaded it is taken by a lift truck to the loading dock and placed at the end of the bench where the same size saggers are being used.

The finished ware in skid frames is moved by lift truck to the Stores Department where it is stored in the same frames, making it easy to move it again to the Shipping Department by lift truck when shipment is to be made.

## Economies Affected

Two men in a kiln, one to stack saggers in bungs, and the other to assist and put on wads, load a kiln in 9 hours or less. Three or four placers, depending on the class of ware, will load enough saggers for one kiln in 9 hours. By the old methods a gang of 8 to 10 men was required working both night and day—a total of 20 hours—to place ware and load a kiln. The new method therefore requires a total average of about 50 labor hours as against about 180 for the old. In addition, this makes it always possible to load a kiln every day and start firing the same night, resulting in an increase in the number of kilns fired per month, as well as reducing the cost of loading.

A saving of labor is made in unloading kilns, though a direct comparison is difficult. One man unloads a kiln in a 9-hour day and one man is required to handle the empty saggers, pallets, etc. It usually takes about four inspectors to take the ware from the saggers and inspect it. Under the old method whereby each sagger was carried out of the kiln by hand, dumped in a tote box and later rehandled when inspected, it required a gang of 5 men working night and day, a total of 20 hours to unload a kiln. There was also more breakage due to "pouring" the ware from saggers into

tote boxes, which is eliminated by the new method. The rehandling by the inspectors is partly saved, but not entirely, as under the new method each piece is handled individually by an inspector, but the loss in breakage is greatly reduced. The use of a lift truck is also considerably more economical than two men carrying a tote box of the finished ware to the Stores Department.

The savings throughout the plant by the use of skids and racks with lift trucks is hard to estimate but appears well worth while. In conclusion, it can be said that the displacement of two men by the use of the above equipment would pay for the interest and depreciation on its cost. It can easily be shown to save the time of at least 10 men, to say nothing of reducing losses of heat in the drying rooms, losses of ware—both green and fired—in transit, and last but by no means least, the increase in the capacity of the plant without the addition of any productive equipment.

# AN EXPERIMENT IN ELECTRIC SMELTING GLASS ENAMEL[1]

By E. E. Geisinger

ABSTRACT

Operating economies will require smelting of enamel frits in electric furnaces. A refractory enamel containing high content of metallic oxides was smelted in a combination arc and carbon resistor furnace, obtaining complete fusion without reduction of the oxides or change in character of the enamel.

## Introduction

The stimulus to carry out the experiment of smelting glass enamel by electric energy rather than by oil or gas, as is the present practice, was found in the many estimates and predictions that the oil and natural gas shortage will be very acute not many years distant. The deserving place of the electric enamel furnace is rapidly being recognized, and a high temperature electric smelting furnace is just a step ahead. The success of the full carbon arc cylindrical type rotating furnace and of the smothered arc rocking furnace is well established in the non-ferrous alloy foundry industry, and they also are successful in the steel casting foundry. It may not be so far distant when the whole enameling plant energy will, economically, be electricity, hence the importance of knowing the fundamental results of enamel smelting by electric energy.

## Conditions of Smelting Electrically

**The Furnace Used.**—The temperature requirement of approximately 2500°F makes any type of metal resistor furnace quite impossible, so a study was made of the different types of commercial arc, smothered arc, and combinations of these two types. When operated most economically, the atmosphere of these furnaces would be reducing, which condition is not correct for the smelting of any glass enamel and especially those containing metallic oxides. It is possible to run a smothered arc furnace neutral to slightly oxidizing, however, at the expense of an excessive consumption of the granular carbon resistor. The General Electric Company are building furnaces of the carbon arc and granular resistor type, in which the heat is transmitted to the bath partly through the trough refractories, but mostly by radiant reflection from the arch. This type of furnace would be more free from electrode residue dropping into the enamel bath.

Through the courtesy of the General Electric Company, and the kind help of Messrs. Lockwood, Lips and Keene of that company, arrangement was made to carry out the tests of smelting on April 14 and 15, 1920. The glass used was a blue-black enamel containing manganese, nickel and cobalt. This enamel was selected not only because of its high metallic oxide content that would rapidly show the effect of reducing atmosphere,

[1] Read before the Enamels Division, St. Louis meeting, Feb. 28, 1922.

but also because a high temperature is required to melt it properly. It is essentially a ground coat enamel.

The furnace used was small but identical in essentials to the large two-ton size. It had two large vertical electrodes descending into a granular resistance trough, which circled the 9″ x 9″ hearth in the center of the furnace. A sketch of the fundamentals of this furnace is shown in Fig. 1. This furnace would very readily receive an eight-inch high crucible, the size used in these tests. The glass used was a blue-black enamel containing manganese, nickel and cobalt.

**Operation and Results.**—In the first smelting experiment, the furnace was running on a load of 450 amperes at 60 volts, and registering a temperature of 1400°C or 2652°F. Carbon monoxide could be seen burning out of the cracks and openings of the furnace, but no attempt was made to obviate this. A 400-gram charge of the raw batch was introduced. At the end of 5 minutes it had gone down considerably, and was bubbling vigorously. At the end of 12 minutes, the glass was liquid and quiet. It was then poured into cold water as is the usual practice.

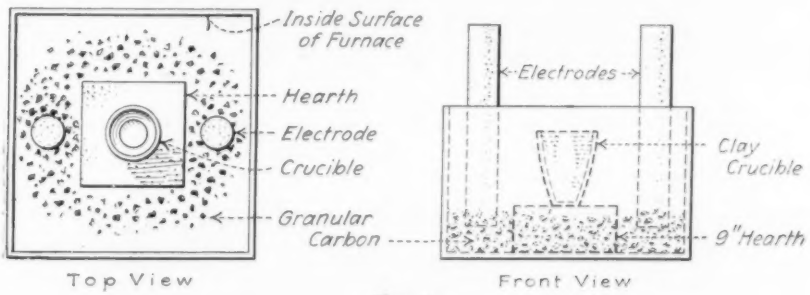


FIG. 1.

The liquid enamel was perfectly smooth, and free from unmelted pigments. The frit was black, sharp and glossy, and appeared identical to a gas or oil smelted enamel of the same formula.

A second test was run the following day. The furnace was heating up from 8 until 11 A.M., pulling anywhere from 350 amperes at 55 volts to 450 amperes at 60 volts and had attained by 11 A.M. 1250°C or 2272°F. A 600-gram charge was made at this temperature, although we knew that the furnace was not hot enough to properly melt the batch. This gave us an opportunity to note the effect of a long time period under these conditions. At the end of one hour and 10 minutes, the batch was quiet and the enamel was poured.

This batch appeared just a little undersmelted and contained a little unmelted material. The frit was vitreous, black and glossy, being all right in every visible respect. It would string out to a good, smooth and resilient thread.

FIG. 2.—Nickel and cobalt globules. Mag. × 50. None of these batches were stirred. Heat seems to be the main essential, and the electric furnace had plenty of it. A bulk of the frit smelted electrically is shown in Fig. 3.

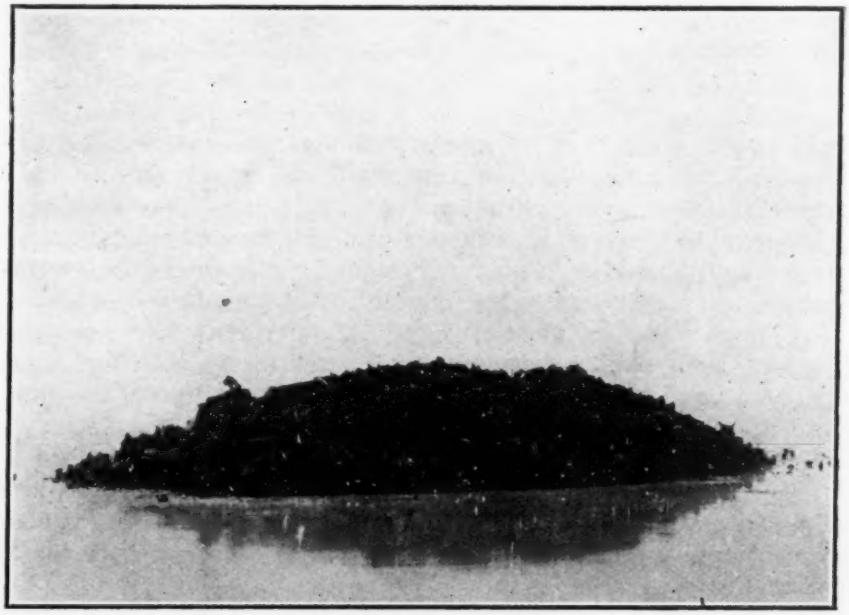

FIG. 3.—Electric smelted enamel frit.

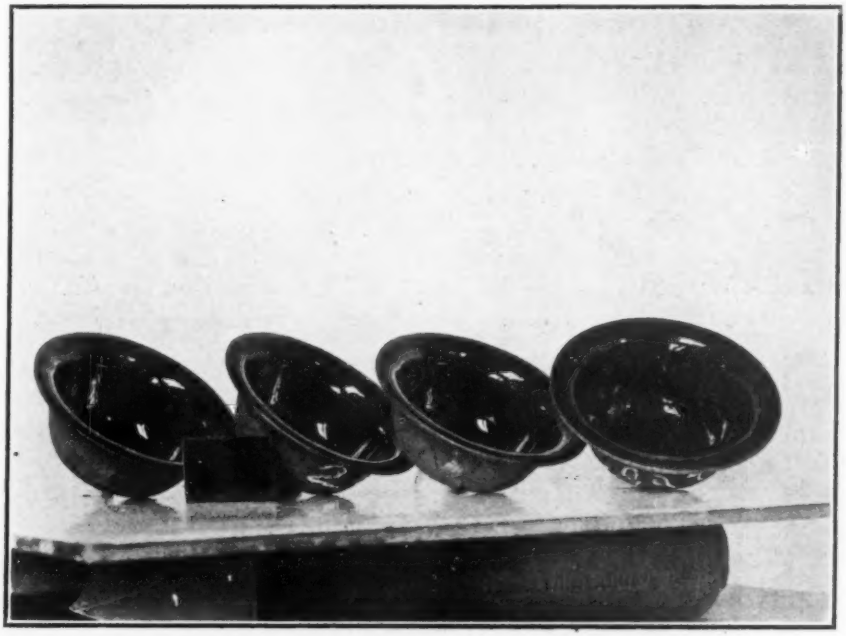

FIG. 4.—Work covered with electric smelted enamel.

FIG. 5.—Top surface view of electric smelted enamel. Mag. × 75.

## Examination for Evidence of Reduction

These two yields of frit were combined, totalling 650 grams of electrically smelted enamel. The crucibles were taken to Rochester for examination, along with the frit.

The crucibles were carefully cracked to pieces and the glass residue in the bottoms examined for reduced metals or ummelted material. No evidence of reduction could be found. The glass in the bottom of the crucibles appeared just as solid and the same in every respect as that of oil smelted enamel. Every piece of the 650 grams of frit was combed over and examined, and only three small globules of metallic substance were found.

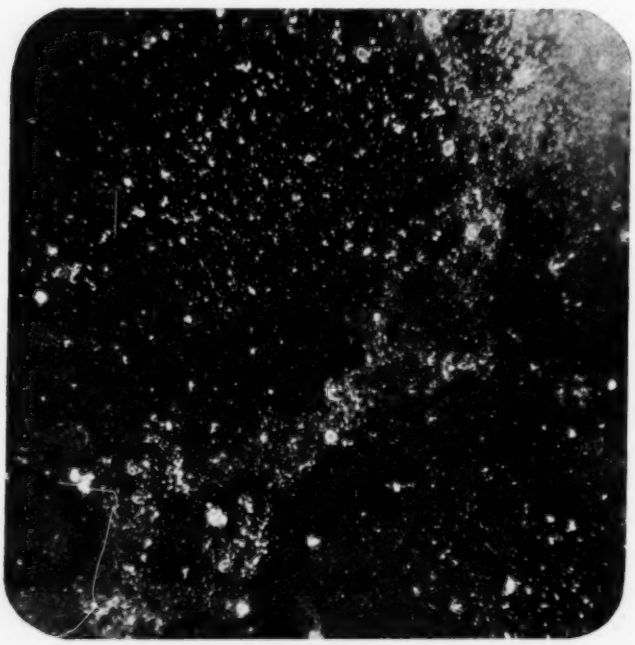

FIG. 6.—Surface of oil smelted enamel. Mag. × 75.

The microphoto of these three globules is shown in Fig. 2.

These pieces were found to be essentially of nickel and cobalt metal. This proved that some reduction had taken place, but it seemed almost impossible for this not to have happened during the second long time period. It was a great surprise to see the ineffectiveness of the furnace gases upon this enamel. A portion of saltpetre was in the batch as in most all enamels of this type, which, of course, inhibited or counteracted the reducing effect of the carbon monoxide in the furnace.

### Application Properties of Electric Smelted Enamel on Steel

The last step in the experiment was to apply the enamel to steel and see if the properties had been materially altered. Four test cups were covered and one small rectangular test piece, which was to be used for microscopic examination. The enamel melted and finished at the same heat and time range as oil or gas smelted enamel. Samples of oil smelted enamel of this formula were applied to ware and fired right beside the electric smelted enamel for comparison. Fig. 4 shows the work covered with the electric smelted enamel. Fig. 5 pictures the top surface of the electric smelted enamel and Fig. 6 shows the top of the same enamel smelted with oil. Both microphotos are magnified 75 times. The four test cups covered with electric smelted enamel were tested electrically at 700 volts, and withstood this test perfectly. A higher voltage was not tried. A slight surface porosity or pitting can be noticed in the electric melted enamel.

It appears logical to conclude from the results of this small experiment that there is a possibility of smelting enamels electrically, when the balance of the smelting cost swings far enough in favor of electric energy as the heat source.

THE PFAUDLER CO.
ROCHESTER, N. Y.

# THE ADAPTABILITY OF THE GAS-FIRED COMPARTMENT KILN FOR THE BURNING OF CLAY PRODUCTS

By W. D. Richardson

## Introduction

The most notable development in the clay industries of America in the past decade, especially in the latter half of it, is the increased attention given to fuel saving and the increased number of installations of the continuous, regenerative kiln. This has been due to the depletion of natural gas and the increase in the price of coal and fuel oil.

The burning of claywares on cars while they are being progressed through a tunnel, every cross section or vertical zone of which is constantly kept at the same temperature, is an ideal method that has been the dream of clayworkers for no one knows how long, at any rate long before my entrance into the industry. In fact, when I first began the making of dry-pressed face brick, thirty-five years ago, of the half-dozen or so manufacturers who were then making a good quality of dry-pressed brick, one of them was burning his product in a tunnel kiln of his own invention. From that time I have known or been associated with three other men who have designed and patented tunnel kilns for burning brick. The first man, above mentioned, is the only one of these who was able to secure the capital for trying out his invention. He certainly put out some excellent brick but, as his plant was well fenced in and no visitors allowed, we can only guess why the business turned out to be a failure.

These remarks are not made to discredit the tunnel kiln, since these early inventors attacked the hardest problem, even for the tunnel kiln of today, that of burning the heavier and cruder products of the common, impure clays. The tunnel kiln, like every improvement in manufacturing processes, has been evolved from repeated failures. Undoubtedly further improvement in the tunnel kiln will make it most advantageous under some conditions and for some products.

It should be noted, however, that comparisons are made with the old periodic kiln and not with the latest developed continuous kilns of other types.

I have had several years' experience in the operation of the compartment kilns and have given considerable thought to their improvement. It is true, my experience with the compartment kiln has been entirely in the burning of face brick and hollow building tile, but since producer gas has become such a practical fuel for ceramic and metallurgical operations the compartment kiln can easily be adapted to the burning of any kind of ware and has a wider range of usefulness, as we will attempt to show, than any other type of kiln.

## The Compartment Kiln

It is understood that we mean by the compartment kiln a series of kilns, in juxtaposition, separated by a common wall and connected with each other by openings in the walls above or below the floor level, the kiln being in continuous operation, the air for combustion of fuel being heated by passing through compartments of the burnt ware back of the fire and the hot combusted gases passing through and preheating the compartments ahead of the fire. These kilns are sometimes built in a single row, but preferably in a double row, either in juxtaposition or separated. This continuous kiln was a later development of the Hoffman Ringofen or the annular continuous tunnel or double row of parallel tunnels connected at both ends, now often built in this country as a single tunnel fired from the top and through doorways. This latter might properly be called the tunnel kiln and the so-called tunnel kiln be called the continuous car kiln or the continuous stationary-fire kiln.

The compartment kiln when direct-fired with coal from the top was introduced into this country many years ago, one form coming from Scotland and one from Germany. When properly built and operated, it was a good kiln for brick, giving better results than the annular or continuous tunnel kiln, but costing more to build and keep in repair. This compartment kiln was fired with coal from the top into specially constructed fire boxes or combustion bags, on one or both sides of the compartment. The progress of the burning was rather slow, especially if high temperatures were required, since the combustion bags became more or less filled with ashes by the time the burning was finished and thus the flow of air to the fires through so many of these bags was retarded.

## Importance of Producer Gas as Fuel

The continuous compartment kiln could not have been presented today for the burning of pottery and refractories had it not been for the successful introduction of producer gas. Producer gas has made it practicable to design a compartment kiln for any ceramic product and makes this type of kiln deserving of consideration in any branch of the clay industry.

Producer gas can be conducted to any part of a compartment and in any quantity and its combustion controlled, so that any desired temperature may be reached quickly and oxidizing or reducing conditions maintained at will. As no ash is deposited on the ware and no flame need strike it, no protection for the ware is required.

Gas producers have been and are still made and sold that give serious trouble. Such producers have retarded a more extended use of producer gas, notwithstanding the fact that the making of good combustible

gas from any fuel, wood, peat, lignite, bituminous or anthracite coal or oil, is a simple operation, and, when understood and with the proper equipment, involves very little labor or attention. Lignite and many bituminous coals cause much trouble in many producers from the formation of clinker, and some very elaborate mechanical producers can only be operated successfully on a coal giving an ash that slags at a high temperature. There need be no trouble in making good gas from any old coal, since we have learned to prevent the formation of clinker. To elucidate the gas producer problem would take us beyond the limits and purpose of this paper, which is to show that the compartment kiln, fired with producer gas, has a wide range of usefulness and in many cases is the most practical kiln.

### Experience with Gas-Fired Compartment Kiln

The kilns that the writer has operated, in the burning of high-grade face brick, have compartments of such size that they could be filled with one gang of setters (two tossers and two setters) in two working days. This means that a compartment must be burned every two days. The compartments were two-side firing, 18 feet wide, 43 feet long and 10 feet high, from floor to top of crown inside. When the burning of a compartment was finished, the compartment next ahead of the fire would be red-hot to the bottom and the second compartment ahead of the fire be incandescent half way to the floor and sometimes to the floor. The burners often finished in 36 hours and sometimes, with the more refractory brick, burning to cone 10, in 24 hours' firing. The burning was always ahead of the setting and emptying and the burners and producer men regularly were not on the job from Sunday morning to Monday morning.

During all my experience with the compartment kiln we were burning the same brick also by direct firing in periodic kilns, so that our yearly tabulations showed accurately the comparative consumption of coal in the two forms of kilns. The producer-gas-fired compartment kiln has required less than half of the amount of coal consumed in the periodic kilns. Moreover, the continuous kiln was much more uniform in results, since its operation is more systematic and under better control.

### Adaptability of Compartment Kiln to Pottery

Since, in the burning of pottery wares, uniform results and quick operation are desirable, the compartments should not be too large, though they should probably be larger than most pottery men have been accustomed to. In any case, the compartment should be filled in one working day and burned in 24 hours' firing.

If it is desired to cool the compartments more rapidly, portable crowns

may be used. Such crowns are entirely practical and have the advantage of costing less for repairs than the permanent crown.

One reason that many pottery manufacturers hesitate to install a compartment kiln, or continuous kiln of any kind, even in a new factory, is that it means a somewhat different method of handling the wares from the kiln. The solid row of compartments would block a direct passage from each kiln to the next department, requiring the ware from the bisque kilns being moved a farther distance to get them to the bisque warehouse or dipping room, and the ware from the glost kilns being moved a farther distance to the warehouse or packing room. This, however, does not mean any greater cost of handling, but a different system. Instead of the ware being carried by the kiln drawers to the next department, it must be placed by them on trucks or cars or continuous conveyors. If the kiln is built in a single row, with doors in both ends of each compartment as would generally be the case in a pottery, the conditions are most favorable for economic handling of wares, without conveyors.

## Summary

The advantages of the continuous compartment kiln, gas-fired, are:

1. A saving of 60 to 70 per cent of the fuel used in periodic kilns under the best conditions.

2. A more compact kiln plant, less waste of space in the factory.

3. No coal to be distributed around the plant and no ashes to be removed from around kilns. All the coal unloaded mechanically at one place and ashes removed mechanically.

4. More rapid firing, a larger quantity of fuel can be introduced and no fuel fired in a compartment until it is red-hot throughout. In the compartment kiln, with induced draft, rapid progress can be made and oxidizing conditions maintained and the heat from the combusted gases utilized to the fullest extent in preheating the wares in the compartments ahead of the fire. In a tunnel kiln, whether of the stationary fire or progressing fire type, the capacity of the kiln is limited, since a strong draft does not distribute the heat properly and a weak draft, to overcome this, produces reducing conditions that are sometimes undesirable.

5. Better control of the burning, as compared with the periodic kiln, because of regulation at will of the gas and air, enabling the burning process to be reduced to a system. No special skill required.

6. Greater uniformity of heat distribution—more uniform product.

7. Less cost for repairs than the periodic kiln and the advantage over the car tunnel kiln that repairs can be made without serious interruption of the operation of the kiln.

8. Less cost for operation per ton of ware burned.

9. The advantage over the tunnel kiln that a greater variety of ware, as to size and temperature required, can be burned. Greater flexibility and adaptability. Any compartment may be filled with either bisque or glost ware without interfering with the regular operation of the kiln. The firing may be hastened or slowed up, as desired.

10. No delays due to the sticking of cars or damage to cars or to failure of mechanical pusher.

11. Ware not subject to motion or vibration, as in the car tunnel kiln.

12. No cars to be repaired or replaced.

13. No change in the regular method of placing kilns, though the work is made easier, since the bungs are not as high as in the old type of kilns.

14. The lower height of the bungs and the absence of abrupt heating increase the life of the saggers.

15. The bisque suffers no harm owing to sudden and rapid cooling, as is often the case in tunnel car kiln.

16. The ware may be warmed up by means of pure heated air drawn from cooling chambers, thus making it impossible to sulphur the goods.

While it is true that no single type or form of kiln is the best for all products and conditions, yet it is a fact that, we believe, cannot be controverted, that the compartment, gas-fired continuous kiln has a wider range of practical utility than any other form of kiln.

# TYPES OF GLAZES SUITABLE FOR DECORATIVE INLAY PROCESSES

By Frederick H. Rhead

ABSTRACT

A definition of the inlay process is given. Type of outlines and method of application are discussed. Glaze formulas in present use are noted, and general conditions necessary for the successful execution of this process are outlined.

**Definition.**—The term "Decorative inlay process" is applied to those decorations consisting of a design with a raised, sunken, or flat outline filled in with flat or slightly shaded coats of glaze, preferably colored matte.

It is a kind of cloisonné process with the difference that the outline is not a metallic wire, or strip, although copper, gold and silver wire have been used on the clay surface, and the spaces between the wires have been filled in with glazes.

This process has been used by the Chinese and Japanese potters, and is in general use among the European Art Potters. In this country it has been confined to the individual potter, some of the schools, and to some extent by the faience and tile manufacturers.

**Two Essentials.**—The two essentials are a suitable outline, and a type of glaze that will not readily flow over the outline, and mix or run into the surrounding glazes.

**The Outline.**—If a raised outline is desired, this may be incised in the mold resulting in a raised line on the ware, or it may be applied in slip form by means of a collapsible tube. When the latter process is used various colored outlines are possible in the same design.

When the outline is flat, underglaze black or any other color is practical. Pure manganese well ground is a most satisfactory outline. It is not dry in texture, and the colored glazes will not easily flow over the line.

An excised or sunken line is also very satisfactory. Curiously enough the glazes will not flow into the sunken line unless the glazes are much too heavily applied. If the decoration is being applied to a white or light-colored body, and a darker outline is desired, underglaze color can be rubbed or brushed into the excised line, and the color cleaned from the surface with a sponge.

It is very important that the outline should be clear and firm, and that all areas to be filled in are completely surrounded by the outline color, otherwise there is danger of the glaze flowing or breaking through. It is obvious that a readily flowing glaze is not suitable for this process, especially if an upright or curved surface is being decorated. While the glazes given will not flow readily on upright surfaces, care must be

TABLE I

TYPES OF GLAZE

| | White Matte 03–01 | White Matte 03–01 | White Matte Cone 1–3 | White 10–12 Matte | White Transparent 03–1 | White Transparent Cone 1–3 | White Transparent Cone 8–10 | White Enamel Cone 03–01 | White Cone 1–3 | White Enamel Cone 9–11 |
|---|---|---|---|---|---|---|---|---|---|---|
| White Lead | 200 | 225 | 52 | .. | 330 | 185 | 310 | 355 | .. | .. |
| Feldspar | 110 | 55 | 24 | 500 | 160 | 55 | 240 | 220 | 225 | 435 |
| Flint | 35 | 90 | .. | 125 | 175 | 35 | 225 | 165 | 165 | 125 |
| Whiting | 25 | 12 | 16 | 250 | 45 | 12 | 150 | 90 | 90 | 170 |
| China Clay | 35 | 26 | 20 | 250 | 8 | .. | 50 | .. | 5 | 175 |
| Zinc | 30 | 74 | 5 | 35 | 14 | 10 | 40 | .. | 10 | .. |
| Cornwallstone | 85 | .. | 24 | .. | .. | 55 | 240 | .. | .. | .. |
| Barium Carbonate | 30 | .. | .. | .. | 5 | .. | 17 | .. | .. | .. |
| Tin Oxide | 25 | .. | .. | .. | .. | .. | 10 | 175 | 180 | 50 |
| Ground Flint Glass | .. | .. | .. | .. | 200 | .. | 60 | .. | .. | 85 |
| Borax | .. | .. | .. | .. | 15 | .. | 5 | .. | .. | .. |

These formulas are for white base. The bases can be stained in the usual manner either with raw metallic oxides or with underglaze colors.

taken not to apply them too heavily, or to over-fire the completed work. Preliminary tests should be made for the character of the outline, thickness of glaze coat, and firing temperature. When determining the firing temperature a set of cones should be placed as near to the ware as possible.

**Medium for Glazes.**—A solution of about ten per cent of gum tragacanth is mixed into a glaze of creamy consistency. The glaze should be brushed through a forty or sixty mesh sieve at least twice after it has been mixed with the gum. The medium should be added to the glaze at the time it is to be used. An average painting mixture would be about equal parts gum solution and glaze. The exact consistency of the glaze will depend on the porosity of the ware. More gum, and a thicker consistency is necessary on a very porous body. If the glaze dries too quickly while it is being applied more gum should be added. If the glaze does not settle, or dry, or if it flows outside the outline, the glaze is either too thin, or a too heavy coat is being applied. Only freshly mixed gum may be used.

**Preparing the Gum.**—The flake or powdered gum tragacanth is added to hot water and allowed to dissolve for about twenty-four hours. It is then thoroughly stirred and brushed twice through a twenty or forty mesh sieve. Only enough gum should be mixed for a supply to last about a week. The gum will keep longer if from one to two per cent of salt is added when the mixture is first put through the sieve.

**Brushes.**—For small areas Nos. one, two, three and four ox hair writers' or sable brushes which have had the outer bristles cut away are excellent. A No. five and a No. three sable water color brush cut to half the size at the ferrule make very useful tools. Do not cut the points of the brushes.

**Application, or Glazing Process.**—It is assumed that the design is broken up into average areas of one square inch or thereabouts, and that each area is entirely surrounded by an outline, either raised, flat, or sunken. Some glazes may be juxtaposed without any outline, but it is advisable not to attempt this without considerable experience with the glazes being used.

The glaze is poured into a small crock, and the brush moistened just enough to allow it to be damp and springy. It is then dipped into the glaze at the point, and allowed to take up just enough glaze for a globule large enough to drop off the end of the brush. The brush should not be dipped entirely, or stirred into the glaze. The glaze is really picked up by the end of the bristles of the brush. The process is about as follows:

1. The brush is dipped into water and wiped over a damp flat sponge to take out surplus water.

2. The brush is pointed into the glaze two or three times until it has picked up a fair size globule of glaze.

3. This globule is immediately applied to the surface and the process repeated before the first application becomes dry. The entire applied area should still be moist by the time the surface is covered. If one portion begins to dry before the wash is completed, there is not enough gum in the glaze, or the consistency is too thin. An average consistency for a porous body would test out at 1800 with a heavy liquid hydrometer.

If a vitrified body is being decorated, two or three coats of glaze may be necessary, each coat being allowed to become fairly dry, or quite dry before a further coat is applied.

This process like the various other decorative methods is rather difficult to describe intelligibly without illustration or demonstration. There are various points in regard to technique which are adaptable to individual or personal treatments, but there are certain practical essentials which must be recognized. In the order of the process, these essentials are:

First: A clear outline of some character.

Second: The correct consistency for the glaze.

Third: Brushes as described. It may be noted that the ox hair writers' and the cut sable brushes are rather difficult to manipulate at first, and the decorator may try to use the ordinary water color brush, or a brush of larger type. But the colors are floated and not painted or brushed over the surface. The brushes specified are suggested because they have been found suitable after many experiments with various types.

Fourth: The correct thickness of the coat of glaze. When a flat surface is being decorated there is little danger of the glazes running or flowing, but when a vase or upright surface is being glazed there is

bound to be some movement of the surface if the glaze is applied too heavily. After some experience, the decorator can allow for a certain flow. The upper portion of the applied area may be a little heavier than the lower portion. This slight variation in the thickness of the coat will be adjusted by the movement of the glaze during-firing.

Fifth: Care not to over-fire.

**Remarks.**—In general, this process is more suitable for individual work than for regular factory production. Except where the designs are simple and consisting of not more than two or three colors, the process is rather intricate and laborious. But very beautiful effects are possible, and it is an invaluable process for the studio potter, and for high-class commercial art work. As is the case with most of the decorative processes, important work should not be attempted until trials and tests have been made in connection with bodies, glazes, outlines, technique and firing conditions.

# RELATION OF COMPOSITION TO THERMAL SHOCK IN STEEL ENAMELS[1]

By B. T. Sweely

Testing enameled ware for resistance to sudden changes in temperature is rather a broad field, and has been well covered by a number of investigators of this subject. The writer's purpose is not to present a new test nor to draw any very definite conclusions, but I should like to bring to the attention of the people interested the results of some of our experimental work with a few different compositions when subjected to sharp temperature changes.

Any study of the resistance of ware to thermal shock must take into consideration the ground coat as well as the finish coat and the relation of their physical properties to one another. A good ground well burned in is very difficult to separate from the steel, the adhesion of the enamel to metal being well above the strength of ground coat glass itself, as is evidenced by the knocking off of any good ground where a coat of glass remains clinging to the steel. It seems probable, therefore, that failure due to sudden change in temperature is caused by separation of the finish enamel from ground, or failure of one glass or the other to withstand the stresses set up by the sudden temperature change. Under these conditions the elasticity and tensile strength of the glasses play an important part and should be as high as possible for best results.

The stress set up in a piece of enameled ware by a sudden change in temperature can only be due to differences in the rate of expansion or contraction of the steel and enamels, and is, therefore, the primary cause of failure. It must be borne in mind that in suddenly cooling a hot piece of ware, especially what is known as three coat, a very appreciable lag in temperature drop is experienced between enamel and steel, as when the piece is plunged in cold water. In this case the enamel on the outer surface is instantly chilled and contracts, but due to the poor heat conductivity of the enamel itself, the outer layer of enamel may be at the water temperature, while the steel and first coat are still very hot. The stress set up under this condition is often sufficient to exceed the strength of the glass, and spalling, and chipping will result. From the above considerations, therefore, it seems quite probable that even though the coefficients of expansion of enamels and steel were exactly the same, failure might still result if the enamels were applied in a rather heavy coat, the latter having been well borne out by the practical experience of the enamel industry, the work of Shaw and others who have found resistance to thermal shock greatest when the enamels are applied in thin coats.

Again considering the coefficients of enamels and steel, it would seem

[1] Read before the Enamels Division, St. Louis meeting, Feb. 28, 1922.

that if the coefficient of the finish enamel was lower than that of the steel and first coat, the stress set for any given temperature change should be smaller, and the probability of failure decreased. Further, since the adhesion of ground to steel as mentioned is very much above the tensile strength of the glass itself, it would seem logical to increase the coefficient of expansion of the ground coat as much as possible, in order to have as much contraction as possible over the temperature interval occasioned by the loss of heat through the cover enamel when the piece is immersed in the cooling medium. Under these conditions, cover enamel and first coat should contract at a rate more nearly coincident and the stress set up by any sudden temperature change be decreased, and, other limiting factors not interfering, it should be possible to develop enamels so adapted to one another that the resistance of the ware to thermal shock could be materially increased.

With the above points in mind, two first coats were made up of the following composition and coated with the white enamel formula given. The compositions used were as follows:

No. 1 First Coat Melted Weights

| | |
|---|---|
| Feldspar | 34.6 |
| $B_2O_3$ | 13.85 |
| $Na_2O$ | 15.50 |
| Fluorspar | 7.5 |
| $SiO_2$ | 25.4 |
| $MnO_2$ | 2.0 |
| NiO | .5 |
| CoO | .42 |
| Cubical Coeff. | $318 \times 10^{-7}$ |

No. 2 First Coat Melted Weights

| | |
|---|---|
| Feldspar | 55 |
| $B_2O_3$ | 5 |
| Kryolith | 12 |
| $Na_2O$ | 10 |
| Fluorspar | 7.5 |
| BaO | 10 |
| CoO | .5 |
| Cubical Coeff. | $432 \times 10^{-7}$ |

White Enamel Melted Weights

| | |
|---|---|
| Feldspar | 22.2 |
| $B_2O_3$ | 9.8 |
| $Na_2O$ | 8.23 |
| Kryolith | 18.00 |
| Fluorspar | 7.86 |
| Zinc Oxide | 2.00 |
| $SiO_2$ | 31.90 |
| Cubical Coeff. | $334 \times 10^{-7}$ |

This white enamel used on No. 1 first coat produces a ware of about the average resistance to temperature change. A piece of this ware placed over a Bunsen burner, heated to red heat and quenched with water will spall off in one or two trials. The same white enamel applied to the No. 2 first coat and tested as above will withstand the test five or six times repeated without chipping or spalling off.

Since the only known difference in the trials tested was in the ground coat used, the increased resistance to thermal shock is probably due to the higher coefficient of expansion of the No. 2 ground.

We are continuing our work on this phase of the problem and hope to present further data at a future date. The writer draws no conclusions and makes no recommendations but presents the data for what they may be worth to those interested, as the results so far secured seem favorable.

CERAMIC LABORATORIES
COONLEY MANUFACTURING CO.
CICERO, ILLINOIS

## CORRECTION

*This Jour.*, **5**, 209 (1922).

In the Abstract for "The Testing of Silica Brick" by K. H. Endell. Line 2, read "hollow carbon rod" for "hollow carborundum rod."

# CERAMIC ABSTRACTS

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## General and Miscellaneous

**1. Failure of a mortared smoke stack.** VN. *Rev. Mat. Constr. Trav. Pub.*, **147,** 225(1921).—A 54-meter smoke stack attached to a rotary cement kiln which had been standing idle for 10 months, was found to be listing 50 cms. at the top, leaning in the direction from which heavy winds were always blowing. The leaning started 14 meters from the top rim. Analyses of the mortar taken from the inclined portion showed the presence of 1–1.5% of $SO_3$ in the half against the wind while the opposite half had 7–12% $SO_3$. It is conjectured that the far side of the rim became soaked by the driving rain and that the wetting then continued on that side downwards. Sulphur from fuel that was deposited on the chimney lining combined with the lime of the mortar forming gypsum mostly on the side further away from the wind. The swelling of the plaster caused the stack to list. A similar case in Sweden is also cited. LOUIS NAVIAS

**2. Belt, gear and chain drives for grinding mills.** GEORGE J. YOUNG. *Eng. Min. J.*, **112,** 969–71(1921).—Describes installations and discusses merits and faults of these drives as used in ore grinding. S. L. GALPIN

**3. Importance of the mineral industries.** EDITORIAL. *Eng. Min. J.*, **112,** 681(1921).—During quarter ending June 30, 1921, railroads of U. S., hauled 222,000,000 tons freight. Coal and coke 89,000,000; stone, clay, gravel, sand 23,000,000, iron ore 9,000,000,000, crude petroleum 1,000,000; agricultural products 21,000,000; animals and animal prod. 6,000,000; forest prod. 20,000,000; manufactured prod. and misc. 42,000,000. S. L. G.

**4. The Bureau of Mines and Private Investigations.** H. FOSTER BAIN. *Eng. Min. J.*, **112,** 450–3(1921).—Details conditions under which the Bureau may coöperate with industries and individuals for research and investigations. S. L. G.

**5. Preparation of Fuller's Earth in Florida.** STRAUSS L. LLOYD. *Eng. Min. J.*, **112,** 860.—Fuller's earth is found in 6′ to 20′ strata of Upper Oligocene age in Gadsden Co. (North Fla.) and Manater Co. (South Fla.). 12′–14′ overburden is stripped and usually only upper half of earth bed is removed. Raw material is crushed, dried, bolted and bagged. For clarifying petroleum products 15–30, 30–60, and 60–80 mesh sizes are sought. For vegetable oils finer material may be used but very fine condition is undesirable. Ark., Colorado, Calif., Ga., and Mass., are also producing states. S. L. G.

**6. Large production of Fuller's Earth in 1920.** *Eng. Min. J.*, **112,** 410.—Figures taken from *Min. Res.*, **1920,** U. S. Geol. Survey. S. L. G.

**7. Incinerator for mill refuse made of brick and concrete.** H. LUDWIG. *J. Elec. Western Ind.*, **47,** 473(1921).—The incinerator consists of a concrete shell with fire brick lining 14 ft. in diam. at the base and 60 ft. high. The feed pipe is 18 in. in diam. and as much as 400 cu. yds. of refuse can be consumed per 9 hrs. Full details of construction are given. The temp. of the combustion chamber ranges between 800° and 1100°. C. G. F. (*C. A.*)

**8. Review of the most important German patents on flotation with special reference to the patents of Mineral Separation, Ltd.** J. FRIEDMANN. *Metall u. Erz*, **18,** 431–37 (1921). R. S. DEAN (*C. A.*)

**9. Insulating materials.** S. HALEN. *Kunststoffe*, **11,** 137–9(1921).—Review of German patents. C. J. WEST (*C. A.*)

**10. The preparation, transportation and combustion of powdered coal.** J. BLIZARD. Can. Dept. Mines, Mines Branch, *Bull.* **564,** 131 pp.(1921).—This is an extensive treatise, with 39 figures of machinery and plant, and many quotations from recent literature. The subjects treated are: suitable coals; drying and pulverizing; storage and distribution; mixers and burners; use for steam-raising; other uses; cost of plant and of prepn.; safety. The material is mostly compiled; but some results of boiler tests are given. Powd. coal shows a high efficiency in use, due to the very low combustible in the ash and the high $CO_2$ content of the flue gas. The cost of prepn. and delivery to the furnace is said to be from 50 cents to $3.00 per ton. ERNEST W. THIELE (*C. A.*)

**11. Complete gasification of coal.** A. W. WARNER. *Proc. Am. Gas Assoc.* (1921 Convention), Sep. 36 pp. bibliography.—W. reviews the method of complete gasification in 1 machine but in 2 or more chambers as found in Smith's adaptation of Kramer and Aart's double gas plant, and the Tenney process which utilizes bituminous coal for production of carburetor water gas; the method for partial gasification in one machine and chamber as exemplified in steaming of continuous vertical retorts (Beilby, *C. A.*, **15,** 2711); and complete gasification in 2 stages, as found in coal carbonizing plants with blue gas plant or carbureted water gas plant using the surplus coke. With the latter method applied to intermittent verticals at Rochester making coal gas and blue gas, the cost per therm. for the first stage for 8 months of 1921 including fixed charges, based on the price of coal, of 14 cents per M. cu. ft., was 8 cents, while for the 2nd stage with fixed charges of 2.75 cents was 9.2 cents. Since gaseous B. t. u.'s are sold with more profit than B. t. u.'s in form of coke, it looks as if our future choice would lie between rich coal gas dild. with blue water gas and balance of coke completely gasified and the gas enriched with oil. J. L. WILEY (*C. A.*)

**12. Boiler plant efficiency.** V. J. AZBE. *Mech. Eng.*, **43,** 722–4, 726(1921).—The object is to show to what extent boiler-plant wastes are preventable or can be made to balance each other, and to recommend a standard for boiler operation toward which designers and operators may aim. The usual wastes in boiler plants are emphasized by means of tables and curves of boiler performance. 90% efficiency is attainable under favorable conditions, this 90% representing boiler and economizer only. The requirements are severe and with 12,000 B. t. u. coal, 15% excess air would have to be used, flue-gas temp. would have to be no more than 250°F, combustion complete and no C in the ash. The requirements of the ideal boiler installation of today are summarized. J. L. WILEY (*C. A.*)

**13. Fuel saving in modern gas producers and industrial furnaces.** W. B. CHAPMAN. *Mech. Eng.*, **43,** 717–21(1921).—There are 10,000 gas producers in the U. S. Progress made in the past 25 yrs. in gas-producer construction is shown in descriptions of some of the leading types. Any of these with skilled handling can make a gas averaging 160–175 B. t. u., provided the coal is of fair quality and the rate of gasification does not exceed 25 or 30 lb. per sq. ft. per hr., and with a saving of about 25% in coal and in

labor. A further saving in coal can be brought about by using suitable accessories in the gas house, such as pressure regulators, and a temp. recorder. Besides conserving fuel by proper gasification, further economy can be effected by its proper utilization in the furnace. The recuperative furnace holds the greatest promise in this direction, as its field of application is very broad, it being capable of effective use in both large and small operations and for furnace temps., as high as 2700 and as low as 1400°. From 20 to 40% of the fuel can be saved by using a recuperative furnace, such as the Stein, which preheats the air to within 500°F of the furnace temp. The extension of the use of such a furnace to pulverized coal and oil would also result in similar savings. Also in *Iron Age*, **108**, 1671–2(1921). J. L. WILEY (*C. A.*)

**14. Determination of the carbon-dioxide content of flue gases from the firing of steam boilers.** H. WINKELMANN. *Braunkohle*, **20**, 307–10, 326–9(1921).—After dealing with the important theoretical principles of combustion, the various methods for detg. $CO_2$ in flue gases are described. An extensive illustrated description is given of the automatic recording app. manufd. by Ados, Ltd. of Aachen. C. C. DAVIS (*C. A.*).

**15. Determination of the carbon-monoxide and carbon-dioxide contents of producer gas.** H. WINKELMANN. *Wärme u. Kalte-Tech.*, **23**, 229–30(1921).—The gas is first passed through a filter and then through an automatic $CO_2$ recorder driven by an elec. motor where the $CO_2$ content up to 20% is recorded. It then passes to a CO filter filled with a colorless powder which completely absorbs the $CO_2$. This powder becomes red on absorbing $CO_2$ and remains so until its efficiency is exhausted when it loses its red tint; it should last 1–2 weeks. The gas, which then contains only CO and hydrocarbon, passes into an electrically heated combustion oven containing an oxidation material and is oxidized to $CO_2$ which is analyzed and recorded in the usual known manner. About 30 such analyses per hr. can be carried out. J. L. WILEY (*C. A.*)

**16. Gas manufacture and tar recovery with special attention to carbonization of lignites.** KONRAD ARNEMANN. *Gas u. Wasserfach*, **64**, 665–73(1921).—Details are given of construction and operation of plant for gasification of lignite, both in raw form and in briquets. Some data are given in relation to costs, raw material, finished products, and yields. J. L. WILEY (*C. A.*)

**17. Modern Pintsch-generator gas plant and results of operation with different fuels.** H. LICHTE. *Gas u. Wasserfach*, **64**, 635–9, 651–8(1921); 24 figs.—Detailed descriptions are given of the following types of generators built by the Julius Pintsch Co., and their operation together with results of operation: (1) Normal generators with rotary grates, round grates, flat grates, step grates and tap generators; (2) generators for production of tar-free gas with double combustion space or with tar burning, and (3) generators with low-temp. tar recovery. J. L. WILEY (*C. A.*)

**18. Smokeless fuel.** W. STRAFFORD. *Gas J.*, **156**, 806–7(1921).—An exptl. plant has been working successfully for some time on the production of *Fuelite* from refuse coal materials. A smokeless domestic fuel is made as well as good coke of any degree of quality. The refuse is first ground to $^1/_4$-in. size, mixed with crude tar, pressed into open trays about 18 by 7 in. in size coupled together and then passed slowly through the retort, consisting of a 9-in. steel pipe 50 ft. long and heated by crude tar burned in a special type of tar burner (described with diag.). The success of the plant is largely due to this appliance. From 24 tons of refuse, mixed with tar, 25 tons of Fuelite were produced, having a calorific value of 13,556 B. t. u. per lb.; that made from coke dust 12,952 B. t. u. per lb. J. L. WILEY (*C. A.*)

**19. Engineers and chemists. The coöperation of the engineer and chemist in the control of plants and processés.** G. M. GILL. *Engineering*, **113**, 57–9(1922). E. J. C. (*C. A.*)

**20. Smokeless fuel for domestic purposes.** ANON. *Electrician*, **87**, 579(1921).—A brief account of a new continuous oven process. Twenty ovens produce 30 tons of coke per day. They are of the upright type, divided longitudinally into 3 compartments by 2 perforated Fe plates. The retorts are gas-heated. One ton of an av. small slack coal will produce 14 cwt. smokeless fuel, 16 to 18 gals. of tar oil, 6000 cu. ft. of gas, 14 lbs. $(NH_4)SO_4$, 2 to 3 gals. of motor spirit. The coal used in the low-temp. process is generally 2 parts non-coking to one part coking. C. G. F. (*C. A.*)

**21. The control of combustion in furnaces.** F. MARTIN. *Age de fer*, **37**, 905–8, 992–3(1921).—M. calls attention to the use of a recording differentiation pressure gage between ash bed and firebox for controlling combustion in furnaces.

A. PAPINEAU-COUTURE (*C. A.*)

**22. Critical investigation on jig sieves, especially those of Schubert** (D. R. P. **235**, 520) **and Schuchard** (D. R. P. **241**, 779). W. GROSS AND W. GOY. *Metall u. Erz*, **18**, 121–26, 152–58, 177–84(1921).—For upper Silesian Zn and Pb ores the grate screen of Schubert is especially good, followed by the Schuchard corrugated screen and the conically perforated sheet. The quality and accuracy of the sepn. depends on the relation of the free openings to the pressure. The force needed is inversely proportional to the free openings. For *coal washing* there is little difference in screens. R. S. DEAN (*C. A.*)

**23. Theory of the water-gas process.** S. KOHN. *J. Ind. Eng. Chem.*, **14**, 69–72 (1922).—K. discusses the 10 possible and 3 probable combinations of reactions which can be used to explain the water gas process. Demonstration is made of a possibility of drawing conclusions from the compn. of the resulting gases to the actual procedure of the reactions. The applicability of the principles outlined is tested on a series of 9 observations published by Bunte and Harries (cf. Haber, Thermodynamik technischer Gasreaktionen), and their application to catalytic observations is discussed.

J. L. W. (*C. A.*)

PATENTS

**24. Supplying steam to gas producers.** H. F. SMITH. U. S. 1,397,554, Nov. 22 Steam supply to gas producers is regulated by an automatic valve control system depending upon the sp. gr. of the gas produced. U. S. 1,397,555 relates to similar automatic steam supply regulation depending upon the moisture content of the gas produced. (*C. A.*)

**25. Burning liquid fuel in jets.** W. N. BEST. U. S. 1,397,79[illegible] Nov. 22. A flat fan-shaped spray of liquid fuel such as oil or tar is delivered to a burner by a vaporizing jet of steam or air and burned together with finely divided coal in a flat fan-shaped flame for heating furnaces or oxidizing Cu or other materials. U. S. 1,397,792 relates to an app. for burning liquid and solid fuels together in this manner. (*C. A.*)

**26. Clay mixture for earthenware manufacture.** C. E. FULTON. U. S. 1,398,014, Nov. 22. A mixt. of good plasticity with a low $H_2O$ content is formed of clay 100, gallic acid 0.02, Na silicate 0.0224 parts, with or without NaOH 0.02 part or a small amt. of other alk. hydroxide. (*C. A.*)

**27. How heat losses in chemical plants may be reduced.** JOHN PRIMROSE. *Chem. Age* (N. Y.), **29**, 449–50(1921).—A plea for greater attention to proper boiler settings, firing, use of economizers, preheaters, insulation, etc., in order to save fuel. Superheated steam for power generation and for high temp. process work, combination of processes so as to utilize steam as in a step-down transformer, satd. steam for temps. up to 300°F, and oil or other fluid heat transference, are discussed briefly.

W. C. EBAUGH (*C. A.*)

**28. Furnace for enameling ceramic or other ware.** R. ROADHOUSE. U. S. 1,395,732, Nov. 1. The furnace is adapted to be heated by oil burners. (*C. A.*)

**29. Clay-working machinery.** WALTER A. GRURNBERG. U. S. 1,394,495, Oct. 18,

1921. In a clay-working machine, a base, a rotatable top thereon, molds on the top, means for rotating the top a quarter of a turn at a time, means for opening and closing the molds, and means for brushing out the molds, means for inserting clay into the molds, means for coring out the molded clay, and means for opening the molds to deliver the molded product at each successive turn of the machine top. C. M. S., JR.

**30. Phosphate-rock-calcining process.** MARK SHOELD. U. S. 1,393,839, Oct. 18, 1921. The process of calcining phosphate rock consisting in suddenly heating the material to be treated to the reaction temperature in form approx. from one to 5 seconds to prevent any substantial preliminary detrimental heat action on the material.

C. M. S., JR.

## Apparatus and Instruments

**31. A new optical pyrometer for high temperatures.** G. KEINATH. *Elektrotechn. Z.*, **42,** 1384–6(1921).—A detailed description of the new "ardometer" of the Siemens-Halske Co. It is a total radiation pyrometer, a modification of the Thwing pyrometer. The thermoelement consists of a small piece of Pt foil, 0.007 mm. thick to which the 2 leads, 0.03 mm. in diam., are hard-soldered. On account of the fineness of these wires the element responds and reaches equil. within 10 sec. The element is sealed into an evacuated glass bulb. At 1400° a reading of 15 mv. is obtained. The ardometer is therefore 4 times as sensitive as the Fèry pyrometer. The minimum temp. accurately read is 600°. Numerous applications are described. C. G. F. (*C. A.*)

**32. Apparatus for the determination of moisture.** F. W. SHULENBERGER. *Paint, Oil and Chem. Rev.*, **72,** No. 25, 8, 14–5(1921).—S. describes an automatically controlled elec. oven with a revolving shelf on which the samples for test are placed. The method for detg. moisture and sediment in oils given in *Bur. of Mines Bull*, No. **5** and the modified method as improved by Dean and Stark are given in detail.

DONALD E. SHARP (*C. A.*)

**33. Automatic recording and analytical apparatus.** L. LEVY. *Chem. Age* (London), **5,** 652–5(1921).—A brief description of recording thermometers and pressure gages, sp.-gr. recorders for gases and liquids, recording calorimeters, total quantity meters, and $CO_2$ recorders. Simmance's sp.-gr. recorder for gases is more fully described than the others. DONALD E. SHARP (*C. A.*)

**34. The differences in the measurements obtained on adiabatic and ordinary calorimeters.** W. SWIENTOSLAWSKI AND MLLES. H. AND Z. BLASZKOWSKIE. *Roczniki Chemji*, **1,** 166–70(1921).—Comparative measurements were made on 2 calorimeters, adiabatic and ordinary, under various conditions. The measurements on the adiabatic calorimeter were made when $t_o$ = const., $t_n$ = const., and under adiabatic conditions. Those on the ordinary calorimeter were made both with and without precautions against the evapn. of the water. The results obtained indicated that identical values could only be obtained under adiabatic and isothermic conditions where $t_o$ = const. In all other cases considerable ($\pm$ 0.03% to $\pm$ 0.46%) differences were observed.

J. M. K. (*C. A.*)

**35. New alternating current electric furnace installation in Dept. of Electrochemistry, Univ. of Toronto.** A. E. R. WESTMAN. *Can. Chem. Met.*, **5,** 224–5(1921).—This dept. has a 200 kilovolt-amp. installation, supplied at 2200 v. 25 cycles, single-phase. Of special interest in the transformer room, are line fuses of 100 amp. 7500 v. limit of the "Sand C" type, $CCl_4$ being automatically projected into the fuse chamber when fuse melts to prevent arcing. Full elec. details are given. F. H. HOTCHKISS( *C. A.*)

**36. Recording calorimeters.** J. W. COBB, J. W. WOOD, *et. al.* *Gas J.*, **156,** 197–201, 740–1(1921).—Discussion of and reply to a report on the Simmance calorimeter (*C. A.*, **15,** 3195). J. L. WILEY (*C. A.*)

**37. Recording combustible gases.** R. MOELLER. *Gas Age-Record*, **48**, 904–7 (1921).—Description and operation of *Mono* equipment for use in boiler, water gas, coal gas and coke oven plants are given. Sample recording charts are shown.
J. L. WILEY (*C. A.*)

**38. Temperature measurements in melting and annealing furnaces in the alloy industry.** F. HOFFMANN. *Metall u. Erz*, **18**, 489–95(1921).—Temp. measurements on melting furnaces are in general without value as well as impracticable to be made. For annealing furnace recording thermocouples are practical and valuable, provided they are properly placed. R. S. DEAN (*C. A.*)

**39. Coal saving in gas works.** ANON. *Gas World*, **75**, 430(1921).—The use of the *W. R. $CO_2$ Indicator* is discussed. (Cf. Ringrose, *These Abs.*, **1**, 4(1922).)
J. L. WILEY (*C. A.*)

PATENTS

**40. Apparatus for effecting circulation and maintaining clean surfaces in stills.** A. D. SMITH. U. S. P. 1,403,980, 17.1.22. Appl., 13.9.19. Means are provided for circulating the liquid longitudinally, and for sweeping the bottom portion of the still crosswise, the sweeping device being caused to oscillate backwards and forwards in the liquid space of the still. A. R. M. (*J. Chem. Ind.*)

**41. Boiler applicable for use as absorber in absorption refrigerating machines.** W. PFLEIDERER. G. P. 343,938, 4.4.15. Two vessels are disposed one above the other, and liquid is forced from the lower into the upper, so that only very little can remain in the lower vessel below the bottom of the tube connecting the two. Loss of liquid due to evapn. of liquid constantly draining from the upper to the lower vessel is thereby compensated. The rate of gas production is appreciably increased, and absorption of gas effected more rapidly, as the gas returning from the lower vessel passes through the absorbing fluid therein and in the upper vessel, in the form of bubbles.
J. S. G. T. (*J. Chem. Ind.*)

**42. Electric furnace.** W. LOHREY. U. S. 1,396,374, Nov. 8. The furnace comprises a mixing crucible within which metals such as Zn, Al, or Cu and Mg supplied from other crucibles within the furnace may be combined. (*C. A.*)

**43. Electric rotating furnace.** C. E. CORNELIUS. U. S. 1,396,677, Nov. 8. The furnace is adapted for melting powdered metallic substances such as Zn which are continuously introduced. (*C. A.*)

**44. Die for making articles of plastic material.** ANDREW W. GATES. U. S. 1,393,014, Oct. 11, 1921. A mold for forming earthenware articles, comprising outer and inner die members shaped to form articles having cylindrical and conical portions and means for rotating one of the members and forcing it longitudinally with respect to the other member. C. M. S., JR.

## Chemistry, Physics and Geology

**45. What happens under a pressure of 300,000 lb. per sq. in.** ANON. *Eng. Min. J.*, **112**, 14.—Extracts from P. W. Bridgman's report in "Compressed Air." S. L. G.

**46. The Euboean magnesite field.** HARRY C. BOYDELL. *Eng. Min. J.*, **112**, 771–3.—These deposits lie about 120 km. north from Athens, in serpentine in Cretacic limestones. Magnesite occurs as replacements along fault and joint fissures, in irregular lenses up to 130 ft. wide and 1800 ft. long, and of undetermined depth. The magnesite is dense cryptocrystalline and usually white. Some deposits are calcareous but the shipping ore is guaranteed 94% $MgCO_3$. Much of the product averages higher. Miners (native) receive 65–70 cts. per day. Ore is hand-picked by women. Part is shipped raw, part, "caustic burned" (to 800°C), part, "dead burned" (to 1500°C). Greek, British and Dutch interests operate mines and furnaces. The product is all exported. S. L. G.

**47. The Callville Wash colemanite deposit.** HOYT S. GALE. *Eng. Min. J.*, **112,** 524–30.—A new deposit found in Jan., 1921, in S. E. Nevada (Clark Co.). Deposit seems to be of thermal spring origin and is in the nature of a large lens, in Tertiary rocks. Estimated 400,000 tons crude colemanite averaging 20% $B_2O_3$ or better. S. L. G.

**48. Converting dolomite into magnesite.** DJEVAD EYOUB. *Eng. Min. J.*, **112,** 771–6.—*Experimental.* Dolomites low in silica were calcined and leached. $(Ca(OH)_2$ said to be about 15 times as soluble in $H_2O$ as Mg $(OH)_2$.) From 950° to 1000°F. (C ? abs.) found to be best temperature for calcination. Residue after leaching found in several cases, to compare very favorably with market material. S. L. G.

**49. Non-metallics and enameled ware—"Consultation."** *Eng. Min. J.*, **112,** 936.—Mentions minerals used in enameling iron, and gives ingredients for one ground, and one finishing coat. S. L. G.

**50. Beutonite, its production and uses—"Consultation."** *Eng. Min. J.*, **112,** 819.—Condensed statement based on Ladoo's pamphlet (U. S. Bureau Mines). S. L. G.

**51. Manifold uses of quartz—"Consultation."** *Eng. Min. J.*, **112,** 101. Summarized statement prepared from *Min. Res.* of U. S. Geol. Survey. S. L. G.

**52. Geology of the Isle of Wight.** H. J. OSBORNE WHITE. *Memoirs of the Geological Survey, England and Wales,* **1921,** 201–202.—Gives a brief review of source of brick and tile material to be found on this island. L. H. COLE

**53. Mineral production of India 1914–1918.** H. H. HAYDEN AND OTHERS. *Geological Survey of India,* **LII,** 1921.—This report gives resumés of the mineral production of India. Among the materials mentioned of interest to the ceramic industry are clays, cobalt, chromite, graphite, bauxite, borax and monazite. L. H. COLE

**54. Economic minerals of Idar State, India.** C. S. MIDDLEMISS. *Geol. Surv. India,* XLIV, **1,** 145–50(1921).—The writer in summing up economic possibilities of this State, mentions the occurrence of ordinary brick clays as well as the kaolin of Eklara and other places which may be of future value. Among other minerals of interest referred to are asbestos, chromite, magnesite, dolomite, talc and steatite. L. H. COLE

**55. Graphite—Recent developments in the Buckingham District, Que., Canada.** V. L. EARDLEY-WILMOT. *Bull. Can. Inst. of Mining and Met.*, **1921,** 539–555.—This paper gives a brief review of the occurrence and origin of graphite in Canada, as well as a thorough discussion of the mining and milling methods in present practice. Graphite products and uses are dealt with at length, the more important ones being crucible flake, lubricating uses, stove polish, foundry facings, etc. A description is given of the mill of the Quebec Graphite Co., at Buckingham, Que. L. H. COLE

**56. A note on colloidal selenium.** A. GUTBIER AND R. EMSLANDER. *Ber.*, **54B,** 1974–8(1921).—It was noticed that the presence of electrolytes had an important influence on the coagulation of colloidal Se by freezing. Since the solns. used contained $H_2SeO_3$ a way was sought to *prepare colloidal Se entirely free from electrolytes.* This was done by pouring hydrazine hydrate over $SeO_2$. The reaction is vigorous, sometimes producing flame. The mixt. should be cooled to prevent loss by evapn. When the $SeO_2$ settles out a blue-red soln. remains. Diffusion expts. with gelatin gel show it to be a true mol. soln. When put into much water it becomes a red colloidal suspension. Hydrazine hydrate also dissolves the gray Se at ordinary temp. A gas contg. $H_2$, $N_2$ and $NH_3$ is evolved, and a soln. which changes in color from brown to deep red forms. It also produces colloidal Se when put in a large excess of water. When dil., these colloids are stable for a week, become streaked on standing but uniform again on stirring. They endure boiling and can be freed from nearly all of the $N_2H_4$ in a Graham dialyzer or by means of parchment paper. $BaSO_4$ ppts. the colloidal Se completely. The stability of the colloid is a function of the degree of dispersion as is shown by the fact that a sample was completely coagulated in 3 days while all weaker concns. required

longer time for pptn. The original colors of the colloids indicated that the more dil. the Se the higher was the dispersion. To test the effect of electrolytes at ordinary temps. 0.0845 g. of gray Se in 1 cc. of hydrazine hydrate was poured into 1 l. of water and dialyzed for 6 days. Solns. of electrolytes 2 *N* in concn. added to equal vols. of this colloid, acted as shown below. On the addn. of HCl, $HNO_3$, $H_2SO_4$, $H_2SeO_3$ and $CH_3CO_2H$, the yellow colloid became successively red, violet and blue. This indicates a growth in the size of particles. $NH_3$ had no effect. NaOH made the color brighter and $Ba(OH)_2$ completely pptd. it. When frozen, coagulation was complete and irreversible. The addition of such substances as HCl up to 0.003 *N*, $Na_2CO_3$ up to 0.013–0.052*N* and KCl up to 0.05 *N*, stabilized the colloid when there was 0.110 g. of Se per 1. and prevented coagulation by freezing. Higher concns. of these salts are efficient coagulants of the same colloid. F. E. BROWN (*C. A.*)

**57. Organogels of silicic acid.** B. S. NEUHAUSEN AND W. A. PATRICK. *J. Am. Chem. Soc.*, **43,** 1844–6(1921).—Graham's statement that one liquid will entirely replace another in silica gels is not entirely true. Silica hydrogels retain as much as 4.8% of water when heated to 300° in vacuum for 6 hrs. Soaking in other liquids does not remove the last small portion of water. High temps. drive out the last traces of water without affecting the structure of the gel appreciably. The last portion of water is held by a force greater than that between the atoms of many stable compds.
F. E. B. (*C. A.*)

**58. Heat of wetting of silica gel.** W. A. PATRICK AND F. V. GRIMM. *J. Am. Chem. Soc.*, **43,** 2144–50(1921).—Careful measurements of the heat of wetting of silica gels were made in an adiabatic calorimeter at 25°. The averages of the observed values in cals. per g. were, for water, 19.22; for $C_2H_5OH$, 22.63; for $C_6H_6$, 11.13; for $CCl_4$, 8.42; for $C_6H_5NH_2$, 17.54. It was detd. that the heat of wetting between 0° and 4° was positive. If the d. of silica gel is assumed to be 2 and the particles 5 $\mu\mu$ in diam. these heat effects could be explained by surface energy. F. E. BROWN (*C. A.*)

**59. Water of Borax Lake.** ROGER C. WELLS. *J. Wash. Acad. Sci.*, **11,** 477–81 (1921).—Analyses in 1863, 1887 and 1921 indicated that the proportions of the salts present have changed since 1863. "In order to represent the dissolved alk. matter in the form of the customary buffer salts, as has been done for Searles brine, an artificial water, contg. 18.5 g. NaCl, 0.5 $MgCl_2$, 1.0 KCl, and 0.03 $CaSO_4$ per l., was made up as a medium to which buffer salts could be added and resulting *pH* values detd. A set of *pH* detns. was then made with various proportions of $Na_2CO_3$ and $NaHCO_3$; the total $CO_2$ was kept equal to that found in the lake water. Another similar set was made with mixts. of borax and $Na_2B_2O_4$; the total $B_2O_3$ was kept the same as found in the lake water." The results are tabulated and shown by curves. The *pH* value of the water was 9.75. To yield this figure the salts should be distributed in g. per l. as follows: $Na_2CO_3$ 5.9, $NaHCO_3$ 3.5, $Na_2B_2O_4$ 2.17, $Na_2B_4O_7$ 0.68. These findings are compared with those of Searles Lake brine in which $pH = 9.48$. The gram ions per l. of Borax Lake are 31.58, those of Searles Lake 444.5. L. W. RIGGS (*C. A.*)

**60. Suggestions for the standardization of geological sections of strata proved in boreholes, shafts, etc.** H. ROSCOE. *Colliery Guardian*, **122,** 1140–2(1921).—A standard comprehensive section of strata met with in coal, Fe and fire-clay mining is lacking. A list of conventional signs and colors which could be understood universally is suggested. C. C. DAVIS (*C. A.*)

**61. A new method for determining silicic acid.** TRAVERS. *Compt. rend.*, **173,** 714–7(1921).—By treating a slightly acid soln. of an alkali silicate with KF in the presence of considerable K salt, the Si can be pptd. completely as $K_2SiF_6$ which can be titrated with alkali hydroxide in accordance with the following equations: $SiO_3^{--} + 6H^+ + 2K^+ + 6F^- \rightarrow K_2SiF_6 + 3H_2O$ and $K_2SiF_6 + 40H^- \rightarrow H_2SiO_3 + H_2O + 2K^+ +$

$6F^-$. Treat the soln. of alkali silicate in a Ag dish with at least 1 g. of KF for each 0.15 g. of $SiO_2$ present. Add HCl until the soln. is neutral to methyl orange and about 2 cc. in excess; then introduce 10 g. of KCl for each 40 cc. of soln. Filter the soln. using a hardened filter and an ebonite funnel. Wash the ppt. with 20% KCl soln., or with 50% alc. until the filtrate is no longer acid to methyl orange and then titrate the moist ppt. with 0.2*N* KOH, using methyl orange as indicator. The results obtained by this method are a little higher than those obtained by the conventional method, *e. g.*, 0.1238 g. $SiO_2$ instead of 0.1230 g. It is applicable for the detn. of Si in the presence of F and to silicate rocks when decomposed by fusion with KOH in Ag crucibles.

W. T. H. (*C. A.*)

**62. An improved iron-manganese separation.** M. CARUS. *Chem.-Ztg.*, **45,** 1194 (1921).—In the usual basic acetate sept. of $Fe^{+++}$ and $Mn^{++}$ the first basic acetate ppt. is likely to contain a little quadrivalent Mn so that it is customary to dissolve the ppt. and repeat the basic acetate pptn. In as much as $MnO_2$ dissolves in dil. acid in the presence of $H_2O_2$ which does not at the same time reduce $Fe^{+++}$, it has been found possible to effect perfect sepns. of $Fe^{+++}$ and $Mn^{++}$ by a single basic acetate pptn. as a result of adding about 3 cc. of 3% $H_2O_2$ to the soln. just before introducing AcONa. The Fe ppt. should be washed with water contg. a little AcOH, some AcONa and a little $H_2O_2$.

W. T. H. (*C. A.*)

**63. Molding sands: their origin and uses.** A. SCOTT. *Colliery Guardian*, **122,** 1404–5(1921).—A general paper, including the physics and chemistry of such sands.

C. C. D. (*C. A.*)

**64. Coagulation of colloids by electrolytes.** H. D. MURRAY. *Chem. News*, **123,** 277–9(1921).—Work on the pptn. of colloids by added electrolytes is reviewed and references are given. The results of different investigators are not comparable because of lack of uniformity in treatment. Six facts seem to have an important bearing on the theory: (1) the sp. action of ions of opposite sign, (2) the greater effect of higher valency, (3) the modifying action of ions of same sign as the colloid, (4) the possible adsorption of equiv. quantities of ions, (5) a minimum necessary concn. of electrolyte, (6) the possible effect of an ion originally present. If work is to be comparable, 4 conditions are necessary; (1) uniform concn. of colloid, (2) quick and uniform mixt. of colloid with electrolyte, (3) uniform treatment after mixing and (4) uniform size of colloidal particles.

F. E. BROWN (*C. A.*)

**65. Catalysis in the interaction of carbon with steam and with carbon dioxide.** HUGH S. TAYLOR AND H. A. NEVILLE. *J. Am. Chem. Soc.*, **43,** 2055–71(1921).—Steam was passed over C at 490°, 525°, and 570° and the vol. and compn. of the gases evolved detd. both in the presence and absence of catalysts. The reaction is (*a*) $C + 2H_2O = CO_2 + 2H_2$. The amt. of CO in the emergent gases was hardly measurable. This reaction takes place in 2 steps (*b*) $C + H_2O = CO + H_2$ and (*c*) $CO + H_2O = CO_2 + H_2$, of which (*c*) is the slower. Good catalysts for (*c*) such as iron oxide do not affect the velocity of (*a*) ; hence (*c*) reaches equil. under these conditions even in the absence of catalysts. Many substances of which $K_2CO_3$ is best are powerful catalysts for (*a*). The same substances are found to catalyze the reaction (*d*) $C + CO_2 = 2CO$. Adsorption measurements show that these catalysts increase the adsorption of $CO_2$ by charcoal. The results conform to the view that a surface complex $C_xO_y$ is formed and the catalysts hasten the decompn. of this complex, thus cleaning off the surface for further adsorption of $CO_2$.

F. L. BROWNE (*C. A.*)

**66. Diamond-drill sampling methods.** R. D. LONGYEAR. *Trans. Am. Inst. Mining Met. Eng.*, **1921,** No. 1107-M, 7 pp.—A brief description of methods for collecting and preserving diamond-drill samples with emphasis on making the sample contain all the core obtainable and all of the cuttings.

C. E. CARLSON (*C. A.*)

**67. Native antimony from Kern County, California.** C. H. BEHRE, JR. *Am. J. Sci.*, **2,** 330–3(1921).—The Sb from Kern Co. occurs as the core of nodules which are coated thinly with alteration products, (1) an unknown, black, Sb mineral, (2) yellow or white valentinite (?), (3) light stibiconite, and (4) a probable intermediate between (2) and (3). EDW. F. HOLDEN (*C. A.*)

**68. Thunder Bay District, Ontario.** T. L. TANTON. Can. Dept. Mines, *Summary Report,* **1920,** Part D, 1–2.—Small but rich deposits of Ag ore on Silver Islet and vicinity were reopened in 1920, galenite and sphalerite being found. **Nipigon-Schreiber District, Ontario.** *Ibid.*, 2–7.—Mining claims were staked in this district as early as 1846. In this and subsequent years Zn, Pb, Cu, Ag, Au ores and anthraxolite were discovered, the Zenith mine being one of the earliest producing Zn mines in Can. At present the mining interests are connected with the Au deposits, and search for Ni in pyrrhotite. Anthraxolite was found on the C. P. Ry. 1 mi. west of Rossport; it is high in C and resembles anthracite, but is regarded as an altered liquid bitumen. **Oil possibilities of Manitoulin Island.** M. Y. WILLIAMS. *Ibid.*, 26–33.—An oil spring was discovered about 1650. Some drilling was done. The results of recent work prove that oil is not present in com. quantities. Logs of 5 wells are given. Analyses of 3 samples of oil gave 54, 48 and 46%, resp., of distillate below 350°. Oil shale of this region contained 65% ash and 35 volatile matter. B. t. u. per lb. 1720, oil yield per ton 7.7 U. S. gal., gas yield 740 cu. ft. per ton. B. t. u. of gas 540 per cu. ft. **Mesozoic clays and sands in Northern Ontario.** J. KEELE. *Ibid.*, 35–9.—Washed cretaceous sand along the banks of the Missanaibi river contained $SiO_2$ 97.72% and $Fe_2O_3$ 0.32. The best clay deposit along the river contained $SiO_2$ 53.10%, $Al_2O_3$ 31.92, $Fe_2O_3$ 1.52, $H_2O$ 12.35, and was exceptionally high-grade as regards refractoriness. **Fluorspar deposits of Madoc District, Ontario.** M. E. WILSON. *Ibid.*, 41–78.—An av. of 16 shipments contained $CaF_2$ 76.61%, $BaSO_4$ 8.13, $CaCO_3$ 9.11, ($Al_2O_3$, $Fe_2O_3$) 3.07, $SiO_2$ 2.74. Along with $CaF_2$ in the fluorspar veins, in the order of their abundance are: barite, calcite, celestite, quartz, marcasite, pyrite, chalcopyrite, tetrahedrite, malachite, and elaterite. **Brockville-Mallorytown Map-area, Ontario.** J. F. WRIGHT. *Ibid.*, 78–84.—Ore shipped analyzed 68% Fe, being either a hard, massive red hematite, or a sandstone impregnated with hematite. "No large body of ore will ever be found." L. W. RIGGS (*C. A.*)

**69. The theory of flotation.** I. TRAUBE. *Metall u. Erz,* **18,** 405(1921).—The flotation problem is a problem of colloid science. The ore pulp is a suspension. The particles in suspension sink under the action of gravity according to Stokes law, *i. e.*, the velocity of settling is proportional to the wt., the square of the radius of the particles and the difference between the sp. gr. of mineral and water, and inversely proportional to the viscosity of the water. To det. the action of other substances on the settling rate of the suspended particles the elec. charge of colloid particles must be considered. Most colloids are negative, including the gang minerals and according to Zsigmondy also the sulfides; however, according to Callow, Wageler and Zimmersbach the metal sulfides are positively charged and the flotation phenomenon is due to the attraction of the negatively charged oil drops by the sulfide particles. Ryschkewitsch's observations, however, do not support this latter view. The hydroxides of Fe and Al are electropositive, the fatty acids as well as aniline bases are negative and quinoline is positive. In general, sedimentation is increased by a colloid of opposite sign and decreased by one of the same sign. The same is true of the addition of ions. Negative suspensions are stabilized by the addition of alkali. The rate of settling is also lowered by the addition of colloids which increase the viscosity of water. The flotation process consists in a reversal of the settling process for some particles but not for others. This depends on the adsorption of the flotation agent on the ore minerals. In this connection the suggestion of Ryschkewitsch that the difference in adsorptive power of

gang and ore minerals is due to the fact that the gang materials have a mol. crystal lattice while the ore minerals have an ion crystal lattice is interesting. This adsorbed material lowers the interfacial tension. The amt. of this adsorption is notably affected by other acids and alkalies, the increase in adsorption of a fatty acid on galena by the addition of $H_2SO_4$ being particularly large. No adsorption by chalcopyrite could be detected by the stalagmometer in the case of cresol, amyl alc. and xylidine, but the ultramicroscope shows that an adsorption takes place. The particles with adsorbed flotation agent are adsorbed at the oil-water interface and thus become a part of the froth, the formation of which depends on the lowering of the surface tension of the water by the flotation agent owing to the absorption of the latter. R. S. DEAN (*C. A.*)

**70. Comments on various methods of attacking mineral ochers.** A. RAYNAUD. *Bull. soc. chim.*, **29**, 905–10(1921).—A rapid proximate analysis of ochers may be made as follows: Dry the finely powd. sample at 105° and then heat over the burner to const. wt. This gives the moisture, hygroscopic and combined. Treat the anhyd. powder with HF and $H_2SO_4$ and, after evapg. to dryness, call the loss in wt. $SiO_2$. Fuse with $K_2S_2O_7$, take up in hot water and reduce the Fe with metallic Zn. Titrate with $KMnO_4$ and thus get the $Fe_2O_3$. Subtract the % of $H_2O$ and $Fe_2O_3$ from 100 and call the difference $Al_2O_3$. W. T. H. (*C. A.*)

**71. Formation and constitution of kaolin.** V. J. BERNAOLA. *Anal. soc. quim. Argentina*, **8**, 392–400(1920).—A theoretical discussion of the mode of formation of kaolin and the supposed occurrence of cryst. particles associated with it. Assuming kaolin to be formed by the removal of Na, K, or Ca silicates from feldspars by soln., the formation of crystals is excluded and the cryst. forms observed are merely pseudomorphs after feldspars. The porous character of kaolin particles implied by its origin as a metasomatic product from feldspars would account for the plastic properties of clays. J. C. S. (*C. A.*)

**72. The colloidal character of clay from the practical point of view.** A. BENCKE. *China Clay Trade Rev.*, **3**, 188–9(1921).—A good review. C. H. K.(*C. A.*)

**73. The flotation of sulfide ores in the laboratory.** W. GROSS. *Metall u. Erz*, **18**, 483–6(1921).—The greatest difficulty with lab. tests is to get comparable grinding conditions. Closed ball mills give too much fine material; the best results are obtained with ball mills with sieves. The amt. of ore used is 5–1500 kg. and the necessary small amt. of flotation agent is added from a buret. For testing machines miniature Janny machines are obtainable and compressed air machines as the Grondal or Callow may be improvised. R. S. DEAN (*C. A.*)

**74. The recently developed magnesite deposits in the Galgenberge, near Zobten, Silesia.** L. VON ZUR MÜHLEN. *Z. prakt. Geol.*, **28**, 155–8(1920).—Compact magnesite occurs in veins in serpentine; it was probably deposited as a colloid from waters which had dissolved the Mg compds. from the upper portions of the serpentine, enriching the deeper part of the rock, and leaving a residual mass of Ni, Fe, and silica minerals. The magnesite later became finely cryst. EDW. F. HOLDEN (*C. A.*)

**75. The bauxite deposits of the Vogelsberges.** H. HARRASSOWITZ. *Metall u. Erz*, **18**, 557–77(1921).—The bauxite is a secondary deposit which was removed from its place of formation by ground waters and laid down in the Pliocene basin. Its first formation resulted from kaolinization of basalt, probably connected with climatic conditions. R. S. DEAN (*C. A.*)

**76. Chromite in northern Macedonia.** C. HÜTTER. *Z. prakt. Geol.*, **28**, 53–9 (1920).—Chromite is found at several places near Raduscha, in lenses in a serpentine carrying microscopic grains. The ore was probably concd. through magmatic differentiation in a periodotite, which later altered to serpentine; it carries 40–50% $Cr_2O_3$. E. F. H. (*C. A.*)

**77. Manganese and manganiferous ores in 1920.** H. A. C. JENISON. U. S. Geol. Survey, *Mineral Resources of U. S., 1920*, Pt. I, 271–83(preprint publ. Dec. 27, 1921). E. J. C. (*C. A.*)

PATENTS

**78. Zinc oxide.** NEW JERSEY ZINC CO. Brit. 165,767, Jan. 14, 1921. In the production of ZnO by volatilizing Zn in a retort and burning the vapor, a considerable body of molten Zn is returned in the retort, and solid Zn is added from time to time in comparatively small quantities, the operation being practically continuous. A suitable construction is specified. Cf. *C. A.* **15,** 2531. (*C. A.*)

**79. Purifying bauxite.** E. EVERHART. U. S. 1,397,414, Nov. 15. Bauxite ores contaminated with clay are disintegrated, agitated in a clay-deflocculating liquid such as dil. NaOH soln. until the clay substances are suspended and the suspended material is sepd. from the granular bauxite. (*C. A.*)

## Refractories and Furnaces

**80. The hardness of refractories at high temperatures.** E. RENGADE AND E. DESVIGNESS. *Céramique*, **25,** 33–37(1922).—The hardness of various silica-alumina

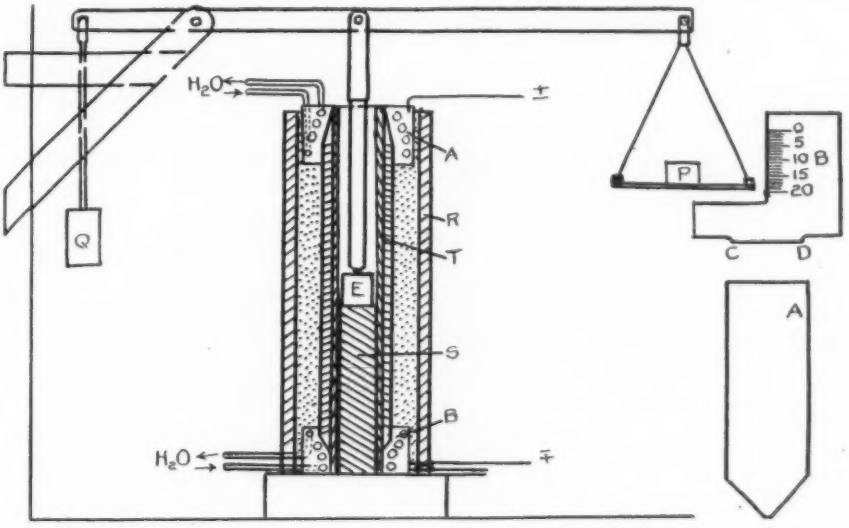


FIG. 1.

refractories were tested by heating small cubes of the material to high temps. in a carbon resistance furnace and forcing a cone-shaped graphite rod into the test piece with a load of 10 kgs. See Fig. 1. The cylinder of graphite has a diam. of 50–60 mm. with a 90° cone. The load is applied for 10 mins. and the impression thus made is measured. The temps. were obtained with an optical pyrometer. The results of the tests are shown in Fig. 2. The chem. analyses of the refractories are as follows:

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|---|---|---|---|---|---|---|---|---|---|
| Loss on ignit. | 0.20 | 0.15 | 0.20 | 0.54 | 0.40 | 0.20 | 0.25 | 0.25 | 0.22 |
| SiO | 70.90 | 85.20 | 80.80 | 72.70 | 71.60 | 70.62 | 57.80 | 67.20 | 26.80 |
| $Al_2O_3$ | 23.60 | 11.30 | 14.72 | 20.00 | 21.00 | 25.80 | 37.50 | 29.07 | 61.70 |
| CaO | 0.35 | 0.20 | 0.45 | 0.20 | 1.15 | 0.80 | 0.60 | 0.90 | 1.30 |

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|---|---|---|---|---|---|---|---|---|---|
| MgO | 0.15 | 0.14 | .. | 0.30 | 0.20 | .. | 0.33 | 0.18 | 0.07 |
| $K_2O$ | 1.30 | 0.91 | 1.90 | 1.00 | 0.18 | tr. | tr. | .. | .. |
| $Na_2O$ | .. | .. | .. | 0.45 | 0.18 | tr. | tr. | .. | .. |
| $Fe_2O_3$ | 2.03 | 1.27 | 1.44 | 4.38 | 4.29 | 1.98 | 3.73 | 2.34 | 6.66 |
| $TiO_2$ | 1.52 | 1.10 | 0.69 | 0.88 | 1.28 | 0.88 | .. | .. | 3.44 |
| Fusion temp., °C. | 1670° | 1680° | 1690° | 1550° | 1630° | 1690° | .. | .. | 1730° |

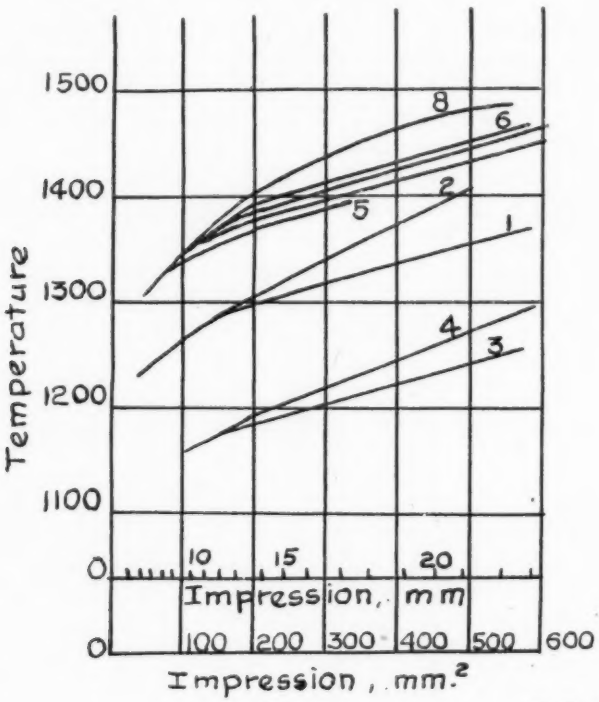


FIG. 2. H. G. SCHURECHT

**81. Report on refractory materials.** W. H. FULWEILER. *Gas Age-Record*, **48**, 653–4(1921).—Progress report of the Comm. on Refractories of the Am. Gas Assoc. For water-gas machine linings chromite, mica schist, and SiC have thus far proved unsatisfactory; zirkite and sillimanite are under observation. J. L. WILEY (*C. A.*)

**82. The operation of basic electric furnaces.** M. W. CARUTHERS. *Iron Age*, **109**, 17–9(1922).—C. discusses at length the 8 major operations of making steel in funaces having movable electrodes. C. G. F. (*C. A.*)

**83. Industrial gas and industrial furnaces.** E. W. SMITH. *Gas J.*, **156**, 816–20 (1921).—S. discusses the industrial application of gas with especial emphasis on *surface combustion*. J. L. WILEY (*C. A.*)

**84. Surface combustion.** H. LININGER. *Z. Ver. Gas-Wasserfach*, **61**, 117–22 (1921).—L. describes the principles, the advantages, the applications and the app. therefor of the surface combustion method of heating as developed by the Surface Combustion Co. of N. Y. J. L. WILEY (*C. A.*)

**85. Comparative calculations on the subject of producer gas in case steamis added to the blow air.** J. SEIGEL. *Rev. metal.*, **18,** 608–18(1921); cf. *Jour. Am. Ceram. Soc.*, **4,** 1008.—Mathematical and graphical calcns. on the variations in calorific power per m.$^3$ of gas, in calorific power per vol. of gas obtained from 1 kg. of fuel, and in the temp. of combustion, when the content in H varies. If different producer gases possess the same potential heat per kg. of fuel, the calorific powers per cu. m. and the temps. of combustion can be diminished only by raising the content in H of the gas. There is no advantage to be expected by injecting steam into the producer either in connection with the yield of potential heat units or in the quality of the gas (the calorific power per m.$^3$ and the temp. of combustion). The real advantage is obtained in decreasing the amt. of clinker formed and in avoiding fuel losses in the clinker; beyond that point the addition of steam is detrimental. J. L. WILEY (*C. A.*)

**86. Moore gas producing system.** ANON. *Gas World*, **75,** 451(1921); fig.—In the Moore system, water gas and coal gas are produced in the same app., which comprises a generator having a vertical retort, of smaller cross-sectional area, in its upper part surrounded by a checkered chamber, primary and secondary air blasts being employed, the latter being utilized to burn the gases from the blow in the checkered chamber, the whole being enclosed in a surrounding shell and the fuel being supplied from the top through a coal valve. Both the feed of coal and extn. of the coke are performed without disturbing the gas-making process. About 35,000 cu. ft. of 425–450 B. t. u. town's gas are produced per ton of coal. The plant can be adjusted for partial or complete gasification. Tar and available $NH_3$ content of the coal are recoverable. A 500,000 cu. ft. per day plant is to be built at Scunthorpe, Eng. J. L. WILEY (*C. A.*)

**87. The use of automatic stokers for high-temperature metal-heating furnaces.** F. VERDEAUX. *Technique moderne*, **13,** 414–7(1921).—The consumption of slack coal (6,600 cal.) per sq. m. of radiating surface (taken equal to the surface of the arch over the grate and extending to the bridge) is given by $C = 3(T_o + T)/(T_o - T)$, where $C$ is the consumption, $T$ the temp. at the bridge, and $T_o$ is 1450° when dry air is blown through the grate and 1400° when steam is used. $T$ is generally 100–50° higher than $t$, the working temp. A large decrease in output corresponds to a relatively small decrease in coal consumption, owing to the very high temp. Therefore close supervision is required for even automatic stokers. A. PAPINEAU-COUTURE (*C. A.*)

**88. Investigation of refractory materials: the after-contraction test.** D. A. JONES. *Gas World*, **75,** 422(1921); *Gas. J*, **156,** 498–9(1921).—Preliminary report from the Inst. of Gas Engineers' Refractory Materials Comm. Whole bricks, not small pieces, are used. The bricks are heated in a surface combustion furnace, the heat being raised for 4 hr. and maintained at the max. temp. (cone 14 for fire brick and cone 12 for silica brick) for 2 hr. Considerable diversity is shown in the readings on account of the unevenness of the surfaces and the dislocation of the surfaces after firing. Marks should be made on the brick, and the variation between these measured by reading microscopes. J. L. WILEY (*C. A.*)

**89. Reversible thermal expansion of silica.** H. S. HOULDSWORTH AND J. W. COBB. *Colliery Guardian*, **122,** 1003(1921).—On burning, the quartz first undergoes a permanent linear expansion, with little or no decrease in d., but an increase in porosity. Further burning to cone 14–16 alters the expansion curve, the quartz being more or less completely changed to crystobalite. A detn. of the true d. of the powdered brick is the best guide to its expansion behavior. C. C. DAVIS (*C. A.*)

**90. Steel-works furnaces and gas producers.** J. S. ATKINSON. *J. West Scotland Iron & Steel Inst.*, **29,** 4–14(1921).—A discussion of the design and operation of mechanical gas producers; of the Stein type of recuperative furnaces and soaking pits; and of American, British, and continental European open-hearth furnaces. Data are given

from comparative runs of similar producers with and without the Chapman floating agitator. The results were in favor of the use of the agitator. Gas-fired furnaces are regenerative, recuperative, or without either regeneration or recuperation. Each type has definite and limited applications. The principal causes of failure in faultily designed recuperators are discussed and the Stein recuperator is described in detail. In discussion J. Mitchell and R. P. Smith express doubt that agitation of the fuel bed of gas producers is an advantage in all cases. LOUIS JORDAN (*C. A.*)

**91. Garrister, its production and uses. Consultation column.** *Eng. Min. J.*, **112,** 537. Brief summary mainly from U. S. G. S. reports. S. L. G.

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**92. Zinc-smelting furnace.** B. RAEDER. Can. 214,692, Dec. 13, 1921. An elec. furnace for Zn production has a chamber heated with energy supplied through C electrodes, a superposed chamber for drying and glowing heated by the combustion of gas and a drying compartment above the latter chamber. The charge is fed successively through the 3 compartments. (*C. A.*)

**93. Basic refractory brick.** S. B. NEWBERRY. U. S. 1,400,087, Dec. 13. A mixt. of lime 2.10 and argillaceous material 3.35 parts is calcined, the proportions of the resulting materials being such that the clinker formed will not disintegrate after prolonged heating or exposure to the air. A mixt. of lime and clay or the like of greater fusibility is added to the clinker and the mixt. is molded and burned as usual in making fire brick. (*C. A.*)

**94. Perforated arch and brick therefor.** ALFRED H. WILLETT. U. S. 1,395,542 Nov. 1, 1921. In an arch construction for fire boxes provided with supporting tubes, the combination of a plurality of reversible fire bricks adapted to be supported in rows upon the tubes, each of the fire bricks being narrower at one end than at the other so that if the bricks in a row be assembled with narrow and wide ends alternating in the adjacent bricks an imperforate arch will be formed, but if assembled with all wide and all narrow ends together, a perforate arch will be formed. C. M. S., JR.

## Art

**95. Coloring doll heads.** ANON. **53,** 486–487(1922).—A new process for coloring doll heads is described. The body must have a high feldspar content, 30%, since high silica bodies become violet. The compn. of the bodies are as follows:

| | | CASTING BODY | |
|---|---|---|---|
| Norwegian feldspar | 31.52 | Norwegian feldspar | 31.54 |
| Lime feldspar | 3.05 | Whiting | 3.05 |
| Zettlitzer kaolin | 52.87 | Zettlitzer kaolin | 51.45 |
| Quartz | 12.56 | Löthainer clay | 2.00 |
| | 100.00 | Quartz | 12.00 |
| | | | 100.04 |
| Soda | 0.2 | | |
| Water | 79.0 | | |

14% of a mixt. composed of 100% $Al(OH)_3$ and 30% $MnSO_4$ dissolved in water is added to the body given above. The mixt. is heated to Seger cone 02*a* in a muffle kiln. The calcine which is now a rose color is then treated with 10% $(NH_4)_3PO_4$ dissolved in water. It is then boiled with 8% $H_2SO_4$ soln. and after drying and grinding is ready for use. The firing should be done in a strictly oxidizing furnace atmosphere, since the iron compounds cause a yellow coloring when not reduced. This yellow together with the Mn rose produces the flesh color. The color is painted on the doll heads by artists and is then fired at low temps. H. G. SCHURECHT

**96. Production of iridescent effects (interference phenomena) for the manufacture of imitation mother of pearl.** F. J. G. VILLFORTH. *Kunststoffe*, **11**, 153–5, 162–4 (1921).—Review of patent literature. C. J. WEST (*C. A.*)

## Abrasives

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**97. Abrasive.** W. MARTINOFF. Brit. 166,713, April 21, 1920. Clay free from arenaceous quartz is heated to 1500–1800° until it becomes grey or black, according to the color of clay used. The material is ground and used as a substitute for emery in abrasive wheels. (*C. A.*)

**98. Grinding compounds.** W. P. THOMPSON. Brit. 169,868, July 27, 1920. An abrasive compd. used with $H_2O$ for metal work consists of powd. carborundum distributed in a jelly of water and starch, flour, or other water-sol. glutinous binder. (*C. A.*)

## Heavy Clay Products

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**99. Drain-tile.** EMORY E. TROWBRIDGE. U. S. 1,393,329, Oct. 11, 1921. In drain tiles the combination with a pair of abutting tubular members, of an enlarged flange portion secured to the end of one tile member and fitting around the abutting end of the other tile, a cup shaped portion carried by the flange and adapted to collect the moisture from the subsoil and permit the seepage through the tiles into the system. C. M. S., JR.

**100. Hollow tile.** JACOB VOORHIS CLOSE. U. S. 1,395,176, Oct. 25, 1921. A building tile having a plurality of differently shaped vertical openings, sundry of the openings having one end wall recessed, the opening at one end of the tile having its outer end wall provided with wire cuts to permit its removal to form a recess at the end of the tile, the side walls of the openings having a recessed end wall being provided with wire cuts, whereby a number of differently shaped units can be formed from the tile, each having a recess in one end. C. M. S., JR.

**101. Brick.** JAMES ALEXANDER PAPOT. U. S. 1,394,759, Oct. 25, 1921. In a wall construction, bricks arranged to provide opposed stretcher rows, alternate built-up sections disposed between the stretcher rows, one of the sections including bricks laid on their side faces and having their adjacent edges disposed in spaced relation to provide a passageway, the adjacent section including bricks laid on their side faces, and bricks positioned on upper side faces of the latter bricks. C. M. S., JR.

**102. Roofing-tile.** RICHARD JOSEPH. U. S. 1,395,423. Nov. 1, 1921. In a roofing tile, a body of plastic material, a transverse rib arranged to engage the roofing strip and a hooked member slidably mounted through the rib and arranged to engage the roofing strip. C. M. S., JR.

**103. Manufacture of bricks.** WALTER WILLIAM CRAWFORD. England 1,395,990, Nov. 1, 1921. The method of mfg. bricks and the like, which comprises burning a suitable gangue in an oxidizing atmosphere, then mixing the burned material with a relatively small quantity of dehydrated cement, then moistening the mixture and pressing the same into form, then immersing the pressed form in cold water, and finally drying the pressed bricks at a low temp. C. M. S., JR.

**104. Arch-protector for clamp-kilns.** FREDERICK GLECKLER. U. S. 1,396,189, Nov. 8, 1921. In a kiln of this class, the combination with a ware arch extending from a furnace opening in the kiln wall, of loosely positioned brick forming a sub-arch or tun-

nel within the ware arch from the furnace, with the spaces between the bricks forming lateral distributing openings for the flame and hot gases of combustion from the sub-arch and into the ware arch. C. M. S., JR.

**105. Brick-cleaning machine.** EDWARD L. MINOR. U. S. 1,397,227, Nov. 15, 1921. A rotatable rack having a concentric series of axial supports with floating metallic disks mounted thereon, and a bed above which the peripheries of the rotating disks will project to engage an article thereon to be cleaned. C. M. S., JR.

**106. Paving-brick.** FRANK B. DUNN. U. S. 1,397,505, Nov. 22, 1921. As an article of manuf. an unpressed paving brick cut from a continuous column of clay having two transverse grooves in one of the die-formed surfaces thereof, and perimetrical studs projecting from the surface of the die-formed surface adjacent to the same relative side of each of the transverse grooves. C. M. S., JR.

**See Abs. 120.**

## Glass

**107. Effect of sulphate and carbonate of sodium on the heats of fusion of soda-lime glass batches.** EMILLE FOURCAULT. *Le Verre*, 251–54(1921); 6–9(1922).—A glass 75.3% $SiO_2$, 12.9% $Na_2O$, 11.8% CaO, *i. e.*, $Na_2O.CaO.6SiO_2$ is taken for an example. The sp. ht. of the glass is calcd. by the law of Woestyn where $C = \frac{a_1}{100} \times e_1 + \frac{a_2}{100} \times e_2 + \frac{a_n}{100} \times e_n$ in which $C$ = sp. ht.; $a$ = per cent compn. of oxide; $e$ = corresponding constant. At 0° $Co = \frac{75.3}{100} \times 0.1913 + \frac{12.9}{100} \times 0.2674 + \frac{11.8}{100} \times 0.1903 = 0.20$. For a temp. $t°$ the sp. ht. is $C_t = Co\ (1 + \alpha t)$ where $\alpha = 0.00078$. For the mean sp. ht. between 0° and $t°$ $C_{mt} = Co(1 + \frac{\alpha t}{2})$. Values for the Co are $SiO_2$ 0.1913, $NaO_2$ 0.2674, $Na_2CO_3$ 0.273, $Na_2SO_4$ 0.231, CaO 0.1903, $CaCO_3$ 0.215; for $C_{mt}$, where $t°$ = 1500°, glass 0.317, $Na_2CO_3$ 0.433, $Na_2SO_4$ 0.366, $CaCO_3$ 0.341, $SiO_2$ 0.302. The following factors are taken into consideration: (1) *The heat required to bring each constituent of the batch to 1500°.* This is calcd. from the $C_{mt}$ data on a mol. wt. basis:

| | A | | B | |
|---|---|---|---|---|
| | Kgs. | Calories | Kgs. | Calories |
| $Na_2CO_3$ | 106 | 68,847 | .. | .... |
| $Na_2SO_4$ | .. | .... | 142 | 77,958 |
| $CaCO_3$ | 100 | 51,150 | 100 | 51,150 |
| $SiO_2$ | 360 | 163,080 | 360 | 163,080 |
| | | − 283,077 | | − 292,188 |

Each batch (A or B) gives 478 Kgs. of glass. (2) *Heat absorbed during decompn.* To decompose 1 Kg. of $Na_2CO_3$ 713.2 cal. per Kg. are required, for $Na_2SO_4$ 952.8, for $CaCO_3$ 451.5 cal. For Batch A, 120,750 cal. are absorbed, and for B, 180,450 cal. (3) *Heat necessary to melt the new silicates formed, and also the excess silica.* The silicates formed will be $Na_2SiO_3$ 0.26, $CaSiO_3$ 0.24, with excess $SiO_2$ 0.50, as mol. per cent. The hts. of fusion are per Kg. $Na_2SiO_3$ 30 cal., $CaSiO_3$ 27.3 cal., $SiO_2$ 30 cal. For 478 Kgs. of glass 14,025 cal. are needed. (4) *Heat liberated by the formation of the silicates.* For $Na_2SiO_3$ 65,000 cal. per Kg., and for $CaSiO_3$ 35,000 cal. per Kg. are liberated. The net results are:

| | A | B |
|---|---|---|
| (1) Heating mixt. to 1500° | − 283,077 cal. | −292,188 cal. |
| (2) Decompn. of carbonate and sulphate | − 120,750 cal. | − 180,450 cal. |
| (3) Heat of fusion of silicates | − 14,025 cal. | − 14,025 cal. |
| (4) Heat of formation of silicates | + 100,000 cal. | + 100,000 cal. |
| Heat absorbed by 1 Kg. mole. of glass | − 317,852 cal. | − 386,663 cal. |
| Or by 1 Kg. of glass | − 665 cal. | − 808 cal. |

Calcns. for 2 other glasses are given: Belgian blown glass, per cent compn. $SiO_2$ 71,850, CaO 14,274, MgO 0.070, $Al_2O_3$ 0.522, $Fe_2O_3$ 0.290, $Na_2O$ 12.944, mol. compn. 0.85 $Na_2O$, 1CaO, 4.55 $SiO_2$. Ht. absorbed per Kg. of glass, for carbonate 583 cal., for sulphate 736 cal., Belgian drawn glass, per cent compn. $SiO_2$ 73.647, CaO 11.080, MgO 0.91, $Al_2O_3$ 0.494, $Fe_2O_3$ 0.303, $Na_2O$ 14.385, corresponding to 1.19 $Na_2O$, 1CaO, 6.13 $SiO_2$. Ht. absorbed per Kg. of glass for carbonate 678 cal., for sulphate 842 cal. LOUIS NAVIAS

**108. The relation between the density and composition of glasses.** W. L. BAILLIE. *J. Soc. Chem. Ind.*, **40**, 141–48(1921).—See Abs. **55**, *These Abs.*, **1**, 19(1922). (*C. A.*)

**109. The manufacture, properties, and employment of heat-intercepting structural glass.** G. ALLEMAN. *J. Soc. Chem. Ind.*, **40**, 241–2T(1921).—The batch for this *actinic glass* as made by the Penna. Wire Glass Co. and expressed in lbs. is $SiO_2$ 1300, $Na_2CO_3$ 400, $Na_2B_4O_7$. $10H_2O$ 20, CaO 200, $NaNO_3$ 40, with decolorizers expressed in g. $MnO_2$ 85, $TiO_2$ 30, "nickel oxide" 35, and 40 lbs. of artificial biotite. The artificial biotite consists of micaceous hematite 40, pptd. $Al_2O_3$ 5, "solid Na silicate" 50, magnesite 5, and $MnO_2$ 30 g. Specimens of this glass $^1/_4$ in. thick transmit 42% of light, eliminating all glare and absorb 78% of heat. The transmission of the luminous rays by different forms of glass varies considerably: Plain polished plate 92.26% of transmission; plain polished wire 68.76%; plain aqueduct wire 40.88%; plain cobweb wire 46.98%; plain ribbed wire 41.96%; plain corrugated wire 44.45%; actinic polished plate 42.02%; actinic rough wire 39.74%; actinic aqueduct wire 21.48%; actinic ribbed wire 32.57%; actinic corrugated wire 29.88%. The transmitted light measured included only that which emanated perpendicularly from the face of the glass. The following figures show the amt. of illumination (due to reflection as well as transmission) in houses of various kinds of glass: Plain polished plate 94.3% of illumination; plain aqueduct wire 81.8%; plain ribbed wire 81.7%; plain corrugated wire 86.0%; actinic rough wire 72.7%; actinic aqueduct wire 47.2%; actinic ribbed wire 77.3%; actinic corrugated wire 77.0%. The wire glass is fire-proof and retains its strength when cracked being suitable roofing material. The glass also finds use in containers of chemicals sensitive to light and heat, and as windshields. It reduces glare in the latter case, and it is claimed is an improvement over ordinary plate glass in aiding the vision when the windshield is covered with raindrops. J. B. PATCH (*C. A.*)

## PATENTS

**110. Sheet-glass drawing machine.** ROBERT P. CALLARD and CLARENCE A. RHONEMUS. U. S. 1,393,081, Oct. 11, 1921. In a continuous sheet glass drawing machine, the combination of a receptacle for molten glass having oppositely-disposed overflow portions, and sheet drawing and width maintaining means, comprising an endless series of edge molding devices movable vertically past each of the overflow portions, for forming the sheet edges and holding them laterally while simultaneously drawing the sheet upward. C. M. S., JR.

**111. Manufacture of glass articles.** ROBERT FREDERICK HALL. England 1,393,118. Oct. 11, 1921. A machine for the manuf. of glass articles comprising a supporting frame, an upper and a lower elongated endless carrier supported in the frame and parallel to each other, the carriers having their opposite faces in proximity to each other during a portion of the travel, means for concomitantly moving the carriers in opposite directions whereby the opposed faces move together throughout a portion of their travel, a series of molding devices on the lower carrier comprising parison and finishing molds, a series of upper mold sections on the upper carrier and adapted to coöperate with the finishing and parison molds, and automatic means for operating the parison molds and upper mold sections for forming glass articles during the portion of travel when the finishing and upper mold sections are moved together in opposed relation. C. M. S., JR.

**112. Method and apparatus for drawing sheet-glass.** JOSEPH E. CROWLEY. U. S. 1,394,283. Oct. 18, 1921. The process of mfg. sheet glass, comprising the simultaneous drawing of a plurality of sheets, passing the sheets about a bending roll in separable contact with each other, continuing the drawing in a plane while still in contact and finally separating the sheets. C. M. S., JR.

**113. Machine for making hollow glass-ware.** EDWARD S. HUTTON. U. S. 1,394,092. Oct. 18, 1921. A machine for making a hollow glass-ware, including a rotary. table, a mold holding frame mounted in the table with guideways in the sides thereof, a blank mold, a blow mold, each of the molds being formed of two vertical halves, stationary means on the outer end of the frame for securing the two outer halves of the molds, a block movable in the frame for holding the two inner halves of the molds, a rod connected with the inner block for moving the inner halves of the molds for opening and closing the molds, the block being radially slidable, and stationary cams near the center of the machine for engaging the inner end of the rod and forcing it inwardly and outwardly. C. M. S., JR.

**114. Glass composition and method of making same.** ELBERT E. FISHER. U. S. 1,394,296. Oct. 18, 1921. A glass comprising more than 60% of silica, one or more oxids of the second periodic group having a thermal expansion of less than 4 as compared to silica, and not more than about 6% of alkali metal oxids of the first periodic group. C. M. S., JR.

**115. Process of manufacture of a glass using natural silicates, such as micaceous minerals, asbestos, and the like.** PERCY BROADBENT CROSSLEY. Calcutta, India. 1,394,973. Oct. 25, 1921. The method of manufacturing glass which comprises dissolving mica in molten glass and maintaining the temperature below that at which the mica effervesces. C. M. S., JR.

**116. Glass roll.** KENJI MATSUO. Tokyo, Japan. 1,394,684. Oct. 25, 1921. A roll consisting of a steel pipe the outer surface of which is perfectly smoothed and covered with a layer of milk glass which is rich in metallic constituents, substantially as and for the purposes herein before set forth. C. M. S., JR.

**117. Process and apparatus for drawing sheet-glass.** IRVING W. COLBURN. U. S. 1,394,809. Oct. 25, 1921. The method of forming sheet glass, consisting in providing a slab within a heated chamber and projecting the discharge end thereof into a temp. which is less than that of the chamber, and causing molten glass to flow onto the slab within the chamber and to be drawn from the discharge end thereof. C. M. S., JR.

**118. Glass-discharging mechanism.** EDWARD S. HUTTON. 1,394,677. U. S. Oct. 25, 1921. The combination of a glass tank, a glass discharge member extending through the wall thereof with its ends projecting beyond the wall, the member having a relatively large glass receiving chamber opening downward in the inner portion thereof and a glass conduit of relatively smaller dimensions in cross-section than the receiving chamber and which extends from the upper end of the receiving chamber at an upward inclination to the discharge end thereof, and means for causing a sudden rising of the glass in the outer portion of the conduit for causing the discharge therefrom of a gather of glass. C. M. S., JR.

**119. Glass-delivery apparatus.** RICHARD T. MCGEE. U. S. 1,394,920. Oct. 25, 1921. Glass delivery app., comprising, in combination with a melting tank, a well located at a suitable distance from the tank, a passage for glass leading outward from the tank in the general direction of the well, a second passage located on a lower level than the first passage, the second passage being in open communication with the well and being adapted to receive glass by gravitation from the first passage and means for producing glass displacement within the second passage for ejecting glass from the mouth of the well. C. M. S., JR.

**120. Manufacture of bricks.** FRIEDRICH BRETTSCHNEIDER. Moravia 1,395,173. Oct. 25, 1921. The process for making bricks which consists in charging plastic material into a mold-frame closing the frame and applying pressure to cause the excess-charge to escape and to be cut off between the mold-frame and cover plates, the pressure being then maintained until the rest of the excess-charge resulting from the elasticity of the mass has escaped through apertures provided for this purpose.

C. M. S., JR.

See Heavy Clay Products.

**121. Method of and apparatus for forming glass tubes.** KARL KUPPERS. Germany 1,395,963. Nov. 1, 1921. A process for the production of reinforced glass tubes which comprises placing a skeleton body upon a suitable mandrel, then placing a glass tube upon the skeleton body and the mandrel, closing one end of the glass tube, evacuating the tube, sealing the other end of the tube, and heating the tube by means of a suitably heated ring-shaped member with relative movement of the tube in order to heat its entire surface whereby the glass passes through the interstices of the skeleton body and conforms to the shape of the mandrel. C. M. S., JR.

**122. Glass-melting furnace.** LAMBTON LE BRETON MOUNT. England 1,395,591. Nov. 1, 1921. A glass melting furnace comprising a tank for molten glass having raised bottom regions at opposite sides, and a vertical flow feed outlet through each such region, a bridge beneath which the molten glass is constrained to flow before reaching the raised bottom portions, fluid fuel burning means at and above one end of the tank, a recuperator at the opposite end thereof, and a casing having recesses below the raised bottom regions of the tank for the reception of molds into which the glass is to be delivered. C. M. S., Jr.

**123. Cooling device for glass-drawing apparatus.** WALTER A. JONES. U. S. 1,396,216. Nov. 8, 1921. A cooling device comprising a stationary support, a cooling ring formed of complemental sections movably mounted upon the support independently of each other, and means for supplying a cooling medium to the sections.

C. M. S., JR.

**124. Art of ornamenting glass articles.** JOHN A. MILLIKEN. U. S. 1,396,691. Nov. 8, 1921. An improvement in the art of ornamenting hollow glass articles comprising inserting a chuck into the article without contacting therewith, temporarily attaching the chuck and the article by an interposed material capable of being applied in molten condition, subjecting the article to the action of an ornamenting apparatus by connecting the chuck and the attached article to the apparatus, and finally changing the physical condition of the interposed material to permit of separation of the chuck and the attached article. C. M. S., Jr.

**125. Method of casting plate-glass and apparatus therefor.** JOHN W. KUNZLER. U. S. 1,396,330. Nov. 8, 1921. The method of casting plate glass, comprising the steps of continuously feeding molten glass into a tiltable vessel, periodically tilting the vessel to pour the molten glass therein onto a casting table across the face thereof, and during such pouring operation moving the table in a direction at right angles to the axis of the vessel to spread the glass in the form of a sheet on the table and during such movement moving the table and glass under a sheet-forming roller to roll the glass to the required thickness. C. M. S., JR.

**126. Sheet-glass forming apparatus.** MICHAEL J. OWENS. U. S. 1,397,326. Nov. 15, 1921. In a sheet-drawing app., a receptacle for molten metal, a sheet drawing means, and an intermediate sheet bending device having a non-glaze destroying face running in contact with the glass at a point distant from the point of formation, the surface of the glass being free from contact with any solid substance until a surface glaze has formed thereon, the movement of the face being different from that of the glass.

C. M. S., JR.

**127. Process of making plate-glass.** JOHN H. MCKELVEY and CHARLES F. RYAN. U. S. 1,397,287. Nov. 15, 1921. The process of making plate glass consisting in first melting the constituents in a furnace, tank, or the like, then conveying and segregating a portion of the molten glass in a collection chamber, then treating the portion by subjecting it to a heat independent of and controlled independently of the furnace for such period of time and at such temperature as to refine such portion, and thereafter depositing the molten glass directly upon a subjacent rolling table and finally rolling same. C. M. S., JR.

**128. Machine for and method of making corrugated wire-glass.** ARNO SHUMAN. U. S. 1,397,149. Nov. 15, 1921. The method consists in rolling a corrugated sheet of wire glass and repeatedly pressing the same corrugated parts of the rolled sheet while still hot. C. M. S., JR.

**129. Sheet-glass drawing machine.** ORLAN P. MARCONET and WILLIAM O. CARTER. U. S. 1,398,109. Nov. 22, 1921. In a machine for mfg. sheet glass, a furnace, means for drawing the molten glass from the furnace, water jackets arranged immediately above the molten mass and at the opposite sides of the furnace, the jackets being designed to receive the edges of the sheet in a manner whereby the edges are cooled and hardened, and also thickened so that the sheet glass lying between the edges is afforded straightness and uniformity in width, and a water inlet and outlet for each jacket. C. M. S., JR.

**130. Glass-rolling mechanism.** JACOB SODERBERG. U. S. 1,398,046. Nov. 22, 1921. In combination in glass rolling mechanism, a table, a roll, supporting tracks extending along the sides of the table on which the roll rests, means for rotating the roll to cause it to move back and forth along the table, and means for automatically lifting the roll from the tracks when it reaches one extreme of movement, comprising a tilting cradle provided with rollers for engaging the roll and supporting it for rotation. C. M. S., JR.

**131. Method for producing flat parallel-shaped glass sheets.** WILLIAM H. TAYLOR. U. S. 1,398,050. Nov. 22, 1921. The process of securing a plate to a flat bed which consists in applying the plate to the bed forcing a mixture of plaster and liquid between the plate and the bed, and allowing the plaster to set. C. M. S., JR.

## Enamels

**132. Uses for industrial enameled equipment.** MAX DONAUER. *Chem. Met. Eng.*, **25,** 1015–20(1921).—Glass enameled units, 25 to 7500 gal., serve 3 general uses, food, pharmaceutical and chem. Advantages over other containers are discussed. R. J. M. (*C. A.*)

## Cement, Lime and Plaster

**133. Influence of drying on the resistance of cement briquettes.** F. ANSTETT. *Rev. Mat. Constr. Trav. Pub.*, **148,** 1–2(1922).—Briquettes of artificial cement, slag cement and of $^1/_3$ mortars with sand of each, were made, and completely immersed in water 24 hrs. after the mixing, for periods of 7, 37 and 90 days. Tensile strength tests were made on some pieces, immediately after removal from the water, and on others at periods of 7, 20 and 26 hrs. after removal from the water. In all cases, the strength of the body was greatest when tested immediately after removal from the water. The strength decreased markedly as the period from the time of removal increased. A. advocates that specifications for such tests be made on the sample immediately after removal from the water. LOUIS NAVIAS

**134. Manufacture and use of concrete building blocks.** *Rev. Mat. Constr. Trav.*

*Pub.*, **145,** 190–92, **146,** 209–11, **147,** 233–34(1921).—A general description of the materials and methods for making agglomerate. The use of building blocks advocated.

LOUIS NAVIAS

**135. Egyptian lime-silica brick.** A. DUPRAZ. *Rev. Mat. Constr. Trav. Pub.*, **147,** 234–36(1921).—General description of 3 lime-silica brick plants in the vicinity of Cairo, Egypt.

LOUIS NAVIAS

**136. Method of chemical analysis of gypsum and plaster.** A. R. *Rev. Mat. Constr. Trav. Pub.*, **147,** 232(1921).—I. *Free water.* By the loss of wt. of a 500 gm. sample heated 2 hrs. at 45°. II. *Fineness of grain.* By screening with the least abrasion. III. *Chemical analysis* made on a 100 mesh sample, dried as in I. (*a*) *Combined water.* 1 gm. charge heated at 215–230° to constant wt. (*b*) *$CO_2$ determination.* The charge from (*a*) is dissolved in 1:4 HCl, and the $CO_2$ collected over soda lime or caustic potash. The increase in wt. is the wt. of $CO_2$. (*c*) *Silica and insoluble matter.* Heat $^1/_2$ gm. sample in a porcelain crucible with 25 cc HCl (1 : 5), to dryness, cool, moisten with conc. HCl, add 10 cc. water, boil, and then filter. Return filtrate to crucible, evaporate to dryness, heating it at 120° for 1 hr., moisten residue with conc. HCl, add 25 cc. water, boil and then filter. Combine the 2 residues, ignite and weigh. (*d*) *Iron and alumina.* The filtrate from (*c*) is boiled with a few drops of conc. $HNO_3$. Add 2 gms. of $NH_4Cl$ in a water soln. and make the soln. alkaline with $NH_4OH$. Heat so as to coagulate the precipitate, then filter. Ignite and weigh as $Fe_2O_3$ and $Al_2O_3$. (*e*) *Lime.* Two methods. (1) To the ammoniacal filtrate from (*d*) add 5 gms. $(NH_4)_2$ dissolved in water, ht. for $^1/_2$ hr., filter. Ignite in a platinum crucible to constant wt. (2) Precipitate and filter as in (1). Transfer the precipitate to a beaker, and re-dissolve it with dilute $H_2SO_4$. Titrate the soln. while hot with $KMnO_4$ soln. (containing 5.6339 gm. per liter), the number of cc. giving directly the CaO. (*f*) *Magnesia.* Dilute the filtrate from (*e*) to about 600 cc.; cool, add 10 cc. $NH_4OH$ and 5 gms. $NH_4NaHPO_4$ dissolved in water, stir till precipitate forms. The following day, filter and wash with $2^1/_2\%$ $NH_4NO_3$ soln., ht. and weigh. Multiply the wt. found by 40/111 for the magnesia. (*g*) *Sulphur trioxide.* Dissolve $^1/_2$ gm. of prepared sample in 50 cc. of 1 : 5 HCl, boil, add 100 cc. of boiling water and continue to boil for 5 min. Filter immediately and wash with hot water. Boil the filtrate, add to it 20 cc. of a soln. of $BaCl_2$ (10% soln.). Let settle for an hr., filter and wash. Ignite with as low a flame as possible till the paper is charred, then strongly for 15 min. Weigh. Multiply the wt. by 80/233 for the wt. of $SO_3$. (*h*) *Sodium chloride.* Dissolve 1 gm. of prepared sample in boiling water, filter. Add 2 or 3 drops of potassium chromate to the filtrate, and titrate with N/20 silver nitrate soln. 1 cc. of standard is equivalent to 0.002923 gm. NaCl.

LOUIS NAVIAS

**137. Portland cement—its testing and specification.** R. E. STRADLING. *Concrete and Constr. Eng.*, **16,** 169–77, 223–33(1921).—A critical discussion of Am., Brit., French and Ger. cement specifications, and cement-testing app. The essential properties of cement as an engineering material are setting time within workable limits, soundness (*i. e.*, no disintegration with aging), and strength sufficient for requirements. When cement is mixed with water a considerable portion of it usually does not hydrate. Every effort should be taken to increase the hydrated portion since the unhydrated portions might more cheaply be replaced with sand. The hydration is apparently affected by (1) fineness of grinding, (2) manner and amt. of mixing, (3) amt. of water used and (4) temp. of water used. The essentials of cement testing are (1) real indications of suitability of the material for the work in hand, (2) independence of the personal equation and (3) shortest possible time.

J. C. WITT (*C. A.*)

**138. Japanese standard rules for testing Portland cement.** ANON. *Eng. World*, **18,** 273–4(1921).

J. C. WITT (*C. A.*)

**139. Heat efficiency increase in cement burning.** H. LAMOUR AND W. C. STEVENSON. *Concrete* (Mill Sect.), **19,** 95–6(1921).—A proposed preheater for cement raw mix is discussed. The app. consists essentially of a vertical cylinder, divided into several chambers, placed above the upper end of a rotary kiln. The kiln gases on their way up the stack are diverted and passed through the preheater where some of the heat is absorbed and some of the dust is recovered. Expts. indicate that the temp. of the gases leaving the preheater is below 700°F and it is calcd. that the installation of a preheater will result in a saving of 24% of the fuel. J. C. WITT (*C. A.*)

PATENTS

**140. Device for dry granulation of slag.** F. RIEDEL. Assr. to The Chemical Foundation, Inc. U. S. 1,404,142, 17.1.22. Appl., 10.8.15. A device for dry granulation of slag comprises a cylindrical cooling wall, an atomising nozzle mounted so as to permit movement in all directions, and means for passing compressed ejecting medium through the nozzle, so that the molten slag may be thrown in a radial direction at any portion of the cooling wall. H. S. H. (*J. Chem. Ind.*)

**141. Cement-kiln plant and method of operating the same.** JOHN E. BELL. U. S. 1,393,738. Oct. 18, 1921. The method of operating a cement kiln plant comprising plurality of rotary cement kilns, a waste heat boiler section and a flue into which the individual kilns open at points at varying distances from the boiler section, and which connects the series of kilns to the boiler section which consists in throttling the connection between each kiln and the flue to such an extent as to make the pressure drop or draft consumption between each kiln and the flue greater than the total pressure drop or draft consumption in the flue and maintaining such draft conditions throughout the connected parts of the system as will compensate for the resistance created by the throttling of the connections and bring about a sufficient and an approx. even draft in the kilns. C. M. S., JR.

**142. Waterproofing composition for cement or similar materials.** H. C. BADDER. U. S. 1,396,546, Nov. 8. A mixt. adapted for waterproofing concrete is formed of clay satd. with Na silicate and dried and burnt clay satd. with $CaCl_2$ and dried. Cement 95–75% is used with 5–25% of the mixed treated silicates and a small amt. of $MgSO_4$ or $CaSO_4$. (*C. A.*)

**143. Waterproofing natural stone.** F. P. JACKSON. U. S. 1,396,118. Nov. 8. Natural stone such as Ohio blue sandstone is freed from moisture by heating and is then impregnated with a hot mixt. of linseed oil 60, paraffin 3 and paraffin oil 40 parts in order to prep. it for use as elec. insulation or for building purposes. Coloring substances also may be used. (*C. A.*)

**144. Cements, mortars, etc.** K. WINKLER. Brit. 167,138. Feb. 1, 1921. Cements, mortars, concretes, etc., are rendered waterproof, adhesive, and quick-setting by being gaged with a metallic chloride soln., such as $CaCl_2$ soln. of 23° Bé., or by the addition of an equiv. amt. of solid chloride to the dry cement. Preferably from $^1/_4$–3% of $Ca(NO_3)_2$, $Sr(NO_3)_2$, $Mg(NO_3)_2$, $MnO_2$, MnO, $BaO_2$, chromic oxide, $Sb_2O_3$, butter of Sb, $Mn(BO_2)_2$ or sugar, or a mixt. of these substances is also added to the cement. The action of the metallic chloride is further intensified if 2–7% of coal cinders, calc-spar, feldspar, bauxite, heavy spar, or fluorspar is incorporated with it during its manuf. from the corresponding carbonate or oxide. (*C. A.*)

**145. Artificial stone.** A. J. SANDERS. Brit. 166,307. March 12, 1920. Recently formed artificial stone, composed of portland-cement mortar or asbestos-cement mortar, is impregnated in succession with solns. of 2 or more metallic salts, which react with one another and with the sol. component of the stone to form a colored ppt. Suitable salts are Pb acetate followed by $Na_2CrO_4$ or $K_4Fe(CN)_6$ followed by $CuCl_2$. (*C. A.*)

**146. Cements.** H. WADE. Brit. 169,807. July 5, 1920. A cement mixt. for use in concretes resisting the action of sea water or sulfated water comprises cement of the kind described in 170,063 with the addn. of finely ground pozzuolana, trass, basic slag, or the like in quantities sufficient to absorb the lime liberated during the setting of the concrete. (*C. A.*)

**147. Cements.** H. WADE. Brit. 169,808. July 5, 1920. Cements are made by calcining mixts. of limestone and leucite, both free from Fe, to which small quantities of metallic oxides are added for coloring purposes. The potash of the leucite is recovered from the kiln gases by condensation and settling in a dust chamber. (*C. A.*)

## JOURNAL AMERICAN CERAMIC SOCIETY

### Preparation of Abstracts

Every article in THIS JOURNAL is to be preceded by an abstract prepared by the author and submitted by him with the manuscript. The abstract is intended to serve as an aid to the reader by furnishing an index and brief summary or preliminary survey of the contents of the article; it should be suitable for reprinting in an abstract journal so as to make a reabstracting of the article unnecessary. The abstract should, therefore, **summarize all new information completely and precisely.** Furthermore, in order to enable a reader to tell at a glance what the article is about and to enable an efficient index of its subject matter to be readily prepared, the abstract should contain **a set of subtitles** which together form a **complete and precise** index of the information contained in the article. This requires at least one and often several subtitles even for a short abstract.

In the preparation of abstracts, authors should be guided by the following rules, which are illustrated by the abstracts in THIS JOURNAL for February and March, 1921.* The **new information** contained in an article should first be determined by a careful analysis; then the subtitles should be formulated; and finally the text should be written and checked.

### Rules

1. **Material not new** need not be analyzed or described in detail; a valuable summary of a previous work, however, should be noted with a statement indicating its nature and scope.

2. **The subtitles should together include all the new information;** that is every measurement, observation, method, improvement, suggestion and theory which is presented by the author as new and of value in itself.

3. **Each subtitle should describe the corresponding information so precisely** that the chance of any investigator being misled into thinking the article contains the particular information he desires when it does not, or vice-versa, may be small Such a title as "A note on blue glass," for example, is evidently too indefinite a description of information regarding "Absorption spectra of glass containing various amounts of copper-cobalt and chromium-cobalt." General subtitles, such as "Purpose" and ' Results" should not be employed as they do not help to describe the specific information given in the article.

4. **The text should summarize the authors' conclusions and should transcribe numerical results of general interest,** including those that might be looked for in a table of physical and chemical constants, with an indication of the accuracy of each. It should give all the information that anyone, not a specialist in the particular field involved, might care to have in his note book.

5. **The text should be divided into as many paragraphs as** there are distinct subjects concerning which information is given, but no more than necessary. All parts of subtitles may be scattered through the text but the subject of each paragraph, however short, must be indicated at the beginning.

6. **Complete sentences** should be used except in the case of subtitles. The abstract should be made as readable as the necessary brevity will permit.

7. The ms. of all abstracts must be typewritten and double or triple spaced.

* The rules were prepared by the Research Information Service of the National Research Council. The Society is indebted to Dr. G. S. Fulcher of the Corning Glass Works (formerly with the National Research Council) for the rules and the illustrative abstracts.

# BULLETIN

of the

## American Ceramic Society

**A Monthly Publication Devoted to Proceedings of the Society, Discussions of Plant Problems, Discussions of Technical and Scientific Questions and Promotion of Co-operative Research**

**Edited by the Secretary of the Society Assisted by Officers of the Industrial Divisions**

F. H. Rhead, M. C. Farren — Art
B. T. Sweely, R. R. Danielson — Enamel
J. C. Hostetter, A. E. Williams — Glass
J. S. McDowell, F. A. Harvey — Refractories
F. K. Pence, C. C. Treischel — White Wares
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## FRANK H. RIDDLE

### President of the American Ceramic Society

Mr. Riddle was elected president of the American Ceramic Society by letter ballot without opposition. For those members who have not had the privilege of meeting him or learning of his record as a ceramist his likeness is here shown and a sketch given.

President Riddle finished his Ceramic Engineering course at Ohio State University in 1907 and since that time has had a broad experience in the manufacture of art pottery, wall tile, porcelain and heavy clay products. He is now consulting engineer and chief ceramist of the Champion Porcelain Company of Detroit and the Jeffery-Dewitt Insulator Company of Kenova, West Virginia.

For two years prior to the war and during the war, Mr. Riddle was a member of the technical staff of the Bureau of Standards. It was he who developed the spark plug used in aeroplanes. The spark plugs made prior to that time would not stand the high temperatures and were a source of disastrous breakdowns. Mr. Albert V. Bleininger, then Director of the Clay Products Division of the Bureau of Standards, assigned Mr. Riddle to this problem and with him made investigations of the compositions and methods of manufacturing that resulted in the spark plug of exceedingly low coefficient of expansion and of very high hot dielectric strength. It was in this study that Mr. Riddle showed best his ability as a ceramic engineer.

FRANK H. RIDDLE

Mr. Riddle has designed, built and managed plants and has installed efficiency methods. His experience as a ceramist and as an executive has been broad. With the support which the ceramic craft has shown willingness to give to an aggressive program of coöperative research and with the leadership of one with so broad and so successful an experience as Mr. Riddle there is every reason for the 1922 record of the Society being the best ever in services rendered to the Ceramic Industries.

## WHY IT IS IMPORTANT THAT CORPORATIONS SUPPORT THE AMERICAN CERAMIC SOCIETY

### Corporations Have Learned Value of the Society to Them

The American Ceramic Society for these past twenty-three years has been building strong and surely as an organization for the promotion of ceramic researches. When it was first launched it was not possible to interest more than thirty-five manufacturers in its support. They were fearful of disclosing their so-called "manufacturing secrets," and had no appreciation whatsoever of the benefits of coöperation. These thirty-five manufacturers, however, did meet and soon found themselves exchanging bits of information and experiences, and even exchanging written notes concerning formulae, equipment and methods. They became so enthusiastic over the benefits of thus meeting together once a year and of having their discussions printed in "Annual Transactions," that they invited others to join with them. Today there are over 1600 joined in this coöperative enterprise, each gaining from the reported experiences of others.

### Low Personal Subscription

Through all of these years, the Board of Trustees of the Society has been determined to keep the personal subscription at a very low figure. The personal subscription is now $7.50. The Board of Trustees has felt, and does now feel, that it is very essential that the personal subscription shall be kept low, so that the young men in the factories and the young men just leaving college and entering into the industry may enjoy the full privileges of the Society without undue tax on their incomes.

### Monetary Value to Corporations

The monetary values of benefits accruing from activities of the American Ceramic Society are much larger and more direct to the corporations than they are to the persons. No corporation would hesitate to pay $25.00 for a bit of information which it thought would be a benefit in either reducing cost or improving product. Many corporations are paying out many times this amount for very much less than they are obtaining from the publications of, and from personal contact in, the American

Ceramic Society. When it is considered that the American Ceramic Society really is an organized research personnel, producing information based on actual laboratory determination and plant application, giving reports of proven facts of value to the manufacturer, the corporations should have no hesitancy in supporting the larger activities in which the Society is now engaged by subscribing to a corporation membership, dues, of which are $25.00 a year.

### Larger Activities of the Society

These larger activities consist altogether in the more thorough organization of the Industrial Divisions and the activities of the Standing Committees, directing their efforts to definite ends, not only in researches themselves, but also in application of the result of researches. In the early days, and more so of late, the publications of the Society have perforce of circumstances been confined more to reports of researches in the fundamentals or scientific and have had to forego the development of personal discussions on the floor of the Conventions and in their publications. The Society has not had the funds to develop the application of the results of these fundamental studies in ceramic science nor given opportunity of exchange of opinion and experiences through discussions.

### Estimated Budget

It is estimated that the Society can enter into, to a very full extent, all of these activities, on a budget not exceeding $40,000 per year. $15,000 of this $40,000 will be realized from the advertising in the *Journal* and *Bulletin*, and the larger part of the remaining $25,000 must be obtained from membership dues. The Society has never made an assessment and it will be the policy of the Board of Trustees that an assessment shall not be levied. It would be defeating the purposes of the Society to raise the personal dues, and therefore it is but natural that the corporations will be asked to pay the small subscription of $25.00 a year in support of this organized promotion of research. They have received, and will continue to receive, the largest monetary benefit, and therefore should be providing for the larger part of the funds that are necessary to sustain the activities of the Society.

This is a statement of facts, not a plaintive appeal.

The Board of Trustees has no fear but that corporations will see the benefits of a virile organization devoted exclusively to the promotion of technical and scientific things in ceramics. They already realize the importance of this in trade matters and they have shown their appreciation of the necessity for organized technical research.

## PERSONAL VERSUS CORPORATION MEMBERS IN THE AMERICAN CERAMIC SOCIETY

The paying of personal dues by corporations has developed the question of personal *versus* corporation dues, because the purpose of each of these classifications is not clear with the members. We have had corporations resign as such when their representatives learned that they could have the rights and benefits of membership for $7.50 a year. Therefore, they argue, why pay $25.00? Other corporations have told their men that their personal subscriptions were to be cancelled since the firm had subscribed as a corporation member. In all but very few such instances we have succeeded in so stating the importance of both personal and corporation memberships that the Society has not been the loser.

We are not questioning the policy of corporations paying personal memberships of employees. In some instances there is advantage in this to all concerned, and certainly no disadvantage to the Society.

### Value of Personal Memberships

**The Society an Educational Institution.**—To the individual, the Society is an educational institution, an opportunity to increase knowledge, acquaintance and outlook, not alone in a particular industry, but in all of the ceramic industries. An investigator or plant operator cannot afford to be without the literature, the forum, the opportunities of cooperation, the broadening knowledge of problems and of their solution in all ceramic lines.

**The Society Broadens Intellectual Opportunities of Members.**—To be without the opportunities of membership in the American Ceramic Society would be limiting one's sphere of knowledge and acquaintance and certainly one's opportunities. The most successful members of university faculties refuse industrial connections because they value the opportunity to engage in research and to publish their results without restrictions. Technical societies give this same sort of opportunity to men in the industry of "letting their light so shine before men that their good work shall be known."

**The Employee's Value to Employer Increased by Activities of the Society.**—A person is given an industrial position and a salary because of what, and in proportion to what, he knows and can do. Keeping abreast of the times is just as important a factor in one's value to a firm as preparation before entering industry. Indeed, he becomes of less and less value to a concern unless he not only keeps abreast with new discoveries, etc., but also makes his contribution to the new knowledge of materials, processes, equipment, and especially of the application to industry of scientific fundamentals.

Technical societies give opportunities for a person to receive from many

co-workers in return for that which he contributes. Thus his knowledge and facilities are manifolded. It is foolish to think that these manifolded returns come in any such proportions to those who attend conventions only for what they can learn, as to those who do things and give to others of their knowledge and experience.

Summing up the advantages of membership to individuals, it can be said in truth that the Society is necessary to the individual if he is to continue his present value or is to increase his value to the concern which gives him employment. A person in the ceramic industry cannot afford to be without a personal membership in the Society.

### Value of Corporation Membership

**The Value of Research Is Recognized.**—The returns from the activities of the Society to corporations are almost directly financial. The importance and value of research to industries is well known. The millions given in support of researches by individuals, and corporations, not alone in industrial but also in public and semi-public laboratories speak with far more force than words concerning the importance of research to manufacturers. The inestimable value to industries of researches done and published by the Federal Bureaus, the Geophysical Laboratory and the several industrial laboratories is well known. There is no longer a reason for anyone to doubt the value of research. The National Research Council is a magnificent monument to the belief of successful manufacturers in the necessity of research in industry.

**The Value in Personal Contact and Discussions.**—That the results of these researches may be applied with greatest profit to the industries, it is essential that the technical men and the plant operators get together to discuss these results from the view-point of conditions in the individual plants. There is value accruing to the corporations when their technical men and their plant operators get together to tell of experiences in plant application of the results of researches.

**The Importance of Researches Made in Plants.**—A great deal of research work is done right in the plants; research that cannot be carried through in laboratories. Such researches are essential to the productiveness of the laboratories. It is just as important for the laboratory investigators to keep posted on the researches made in the factories, as it is for the factory investigators to keep posted on the researches made in the laboratories. This means direct returns to the manufacturers.

It is only in technical societies that the laboratory and the factory investigators can get together to discuss, analyze and make plans for further work.

**The Value in Corporations Exchanging Research Information.**—The technical societies give opportunity for each concern to receive from

all the other contributing concerns in exchange for the information they give. This is a manifolding of returns on investments made in research that should make it plain to every manufacturing concern that it pays to give financial support to technical societies. It is especially vital that the ceramic manufacturers give support to this, the only Society devoted exclusively to the promotion of Ceramic Arts and Sciences.

**The Value of the Society to Corporations Is Direct.**—The returns enjoyed by corporations from the activities of the American Ceramic Society are directly financial, and these returns will be in proportion to the support given.

If the total annual subscription of a corporation was $100 it would be an inadequate measure of the value which the Society has been and can be to each corporation. It matters not how many personal subscriptions a firm pays for its employees it will not be giving support to the Society in proportion to the direct returns enjoyed. The returns to corporations will be in proportion to the number of individuals who make contact with the activities of the Society, hence it behooves a concern to make these contacts through as many of their personnel as is possible, but it is also to their interest to give financial support to the Society that these personal contacts of their employees may be the more productive.

The corporation annual fee of $25.00 is small in comparison with the usual fees, yet it is adequate to meet the budget of the Society, when each of the ceramic corporations will be doing its share.

*Fellow Member!*—Is your firm making your membership of more value to it through an annual corporation subscription? Does this suggest a duty you owe to yourself, to your firm, and the Society?

## AMERICAN CERAMIC SOCIETY EXCURSION TO ENGLAND AND EUROPE

A year ago members of the Society received a communication from Mr. C. O. Grafton inquiring who would be interested in being one of the party to visit England in 1922 in response to the invitation of the British Society of Glass Technology. Several hundred replies to that inquiry were received and in consequence, negotiations with the English Society were commenced with regard to the reception of those of our Society who are interested in things other than Glass. Dr. Turner writes that the Refractories group surely will be welcome. Definite assurance regarding the other groups has not been received but the negotiations are still in progress and the indications are favorable in the case of the White Ware group, and there have been no definitely unfavorable reports.

Accordingly reservations have been made on the Cunard Line Aquitania sailing from New York on August 22, 1922, for the accommoda-

tion of about 40 persons. The rate is $275.00 plus tax ($5.00) per passenger, from New York to Southampton. Furthermore the Cunard Line has given assurance that every effort will be made to insure a comfortable and enjoyable trip. A small group of about ten have already "signed up," but unless a party of at least twenty-five is secured the reservations must be cancelled and the trip postponed. These reservations must be taken up or cancelled before June 29th and so decisions must be made not later than June 1st. Of course an early reply will be necessary from those intending to make the trip. In such a case, deck plans of the Aquitania will be sent so that cabins may be selected. Dr. Turner has in charge the arranging of the tour of England, which will require about three weeks. Special trips will be arranged for the several groups representing the Divisions of our Society. Those wishing to visit the continent will be expected to make their own arrangements since no organized visit will be made. Dr. Endell has assured us of a welcome in Germany and Dr. Turner will assist in arranging tours to the Continent.

The steamship agency in Pittsburgh through which these reservations have been made has offered numerous courtesies regarding the securing of passports, the insurance of baggage and the securing of hotel accommodations in New York for the party for the day or two before sailing. The details of these arrangements will be communicated later to those who are planning to join the party.

Those interested will please notify Dr. E. Ward Tillotson of Mellon Institute, Pittsburgh, Pa., as early as possible.

## THE NEED FOR ORGANIZATION IN SCIENTIFIC RESEARCH[1]

By Elihu Root

Chairman of the Board of Trustees, Carnegie Institution of Washington

Extracted from Vol. 1, Part 1, No. 1, Oct., 1919, *Bulletin of the National Research Council.*

I have no justification for expressing views about scientific and industrial research except the sympathetic interest of an observer for many years at rather close range. One looking on comes to realize two things. One is the conquest of practical life by science: there seems to be no department of human activity in which the rule of thumb man has not come to realize that science which he formerly despised is useful beyond the scope of his own individual experience. The other is that science, like charity, should begin at home, and has done so very imperfectly.

Science has been arranging, classifying, methodizing, simplifying everything except itself. It has made possible the tremendous modern development of the power of organization which has so multiplied the effective power of human effort as to make the differences from the past

[1] Washington, D. C., August, 1918.

seem to be of kind rather than of degree. It has organized itself very imperfectly. Scientific men are only recently realizing that the principles which apply to success on a large scale in transportation and manufacture and general staff work apply to them; that the difference between a mob and an army does not depend upon occupation or purpose but upon human nature; that the effective power of a great number of scientific men may be increased by organization just as the effective power of a great number of laborers may be increased by military discipline.

This attitude follows naturally from the demand of true scientific work for individual concentration and isolation. The sequence, however, is not necessary or laudable. Your isolated and concentrated scientist must know what has gone before, or he will waste his life in doing what has already been done, or in repeating past failures. He must know something about what his contemporaries are trying to do, or he will waste his life in duplicating effort. The history of science is so vast and contemporary effort is so active that if he undertakes to acquire this knowledge by himself alone his life is largely wasted in doing that; his initiative and creative power are gone before he is ready to use them. Occasionally a man appears who has the instinct to reject the negligible. A very great mind goes directly to the decisive fact, the determining symptom, and can afford not to burden itself with a great mass of unimportant facts; but there are few such minds even among those capable of real scientific work. All other minds need to be guided away from the useless and toward the useful. That can be done only by the application of scientific method to science itself through the purely scientific process of organizing effort.

This relation of the scientific worker to scientific work as a whole can be furnished only by organization. All the world realizes now the immense value of the German system of research applied at Charlottenburg and Grosslichterfelde. That realization is plainly giving a tremendous impetus to movements for effective organization of scientific power both in England and in the United States—countries whose whole developments have rested upon individual enterprises. It remains to be seen whether peoples thoroughly imbued with the ideas and accustomed to the traditions of separate private initiative are capable of organizing scientific research for practical ends as effectively as an autocratic government giving direction to a docile and submissive people. I have no doubt about it myself, and I think the process has been well begun in England under the Advisory Council of the Committee of the Privy Council for Scientific and Industrial Research, and in the United States under the National Research Council.

I venture to say two things about it. One is that the work cannot be done by men who make it an incident to other occupations. It can be encouraged of course by men who are doing other things, but the real

work of *organization* of research must be done by men who make it the whole business of their lives. It cannot be successful if parcelled out among a lot of universities and colleges to be done by teachers however eminent and students however zealous in their leisure hours. The other thing is that while the solution of specific industrial problems and the attainment of specific industrial objects will be of immense value, the whole system will dry up and fail unless research in pure science be included within its scope. That is the source and the chief source of the vision which incidentally solves practical problems.

## AMERICAN CERAMIC SOCIETY EXHIBITION

### The First American Ceramic Society Ceramic Display

By Frederick H. Rhead

For the first time in the history of the American Ceramic Society, an exhibition of the various ceramic products was held during the twenty-fourth annual convention. While there was little time in which to plan this exhibit, the response from manufacturers, educational institutions, and studio potters was very satisfactory, and every Division was represented.

The display was not only well attended, but the members were much interested in the exhibits, as was evidenced by the many interesting discussions relating to the various types of ceramic wares shown. The following classification will give a fair idea of the scope of the activities represented.

### Art Division

Schools

The New York State School of Clayworking, under Profs. Marion L. Fosdick and Clara K. Nelson; Prof. C. F. Binns, Director. Included in the group executed by the students of this school were some very charming, and well-finished turquoise vases and bowls.

The Department of Ceramics of Iowa State College, Ames, Iowa, under the direction of Paul C. Cox. This exhibit was particularly interesting because it gave a good idea of the scope of work covered by this school. It is very evident that there is a serious attempt to develop the resources of the state. Different types of clay were used. In this exhibit were examples of art wares, stoneware utilitarian vessels, casseroles, etc., buttons made of red clay, an incense burner, and a small enameled metal bowl.

The Newcomb School of Art, Mary G. Sheerer, Instructor, sent a most dainty group of bowls, tea caddies, and vases made with a light-colored clay and glazed with soft green, and other colored enamels. These pieces were very nicely finished and gave ample evidence of great care, and considerable skill.

The Lewis Institute, Chicago, Illinois, under the direction of W. W. Wilkins, had a group of hand built pottery finished in matte and enamel

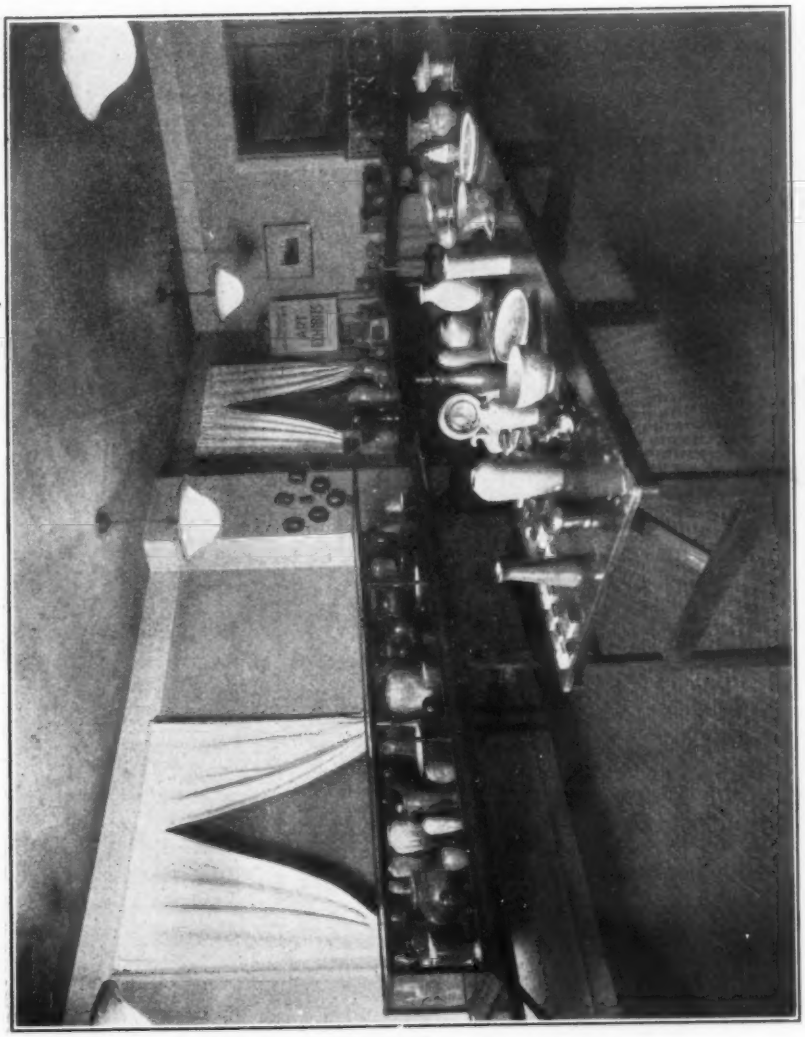


FIG. 1.—View of Art Exhibit. Rookwood Pottery in large case at left. Fulper Pottery in far corner. Vases by Prof. C. F. Binns at right. Overbeck Pottery on table in center.

FIG. 2.—Art Exhibit. Newcomb College and Lewis Institute Pottery on center table. S. A. Weller Pottery, left corner. Paul Revere Pottery, right corner.

FIG. 3.—Refractories and Terra Cotta Exhibit.

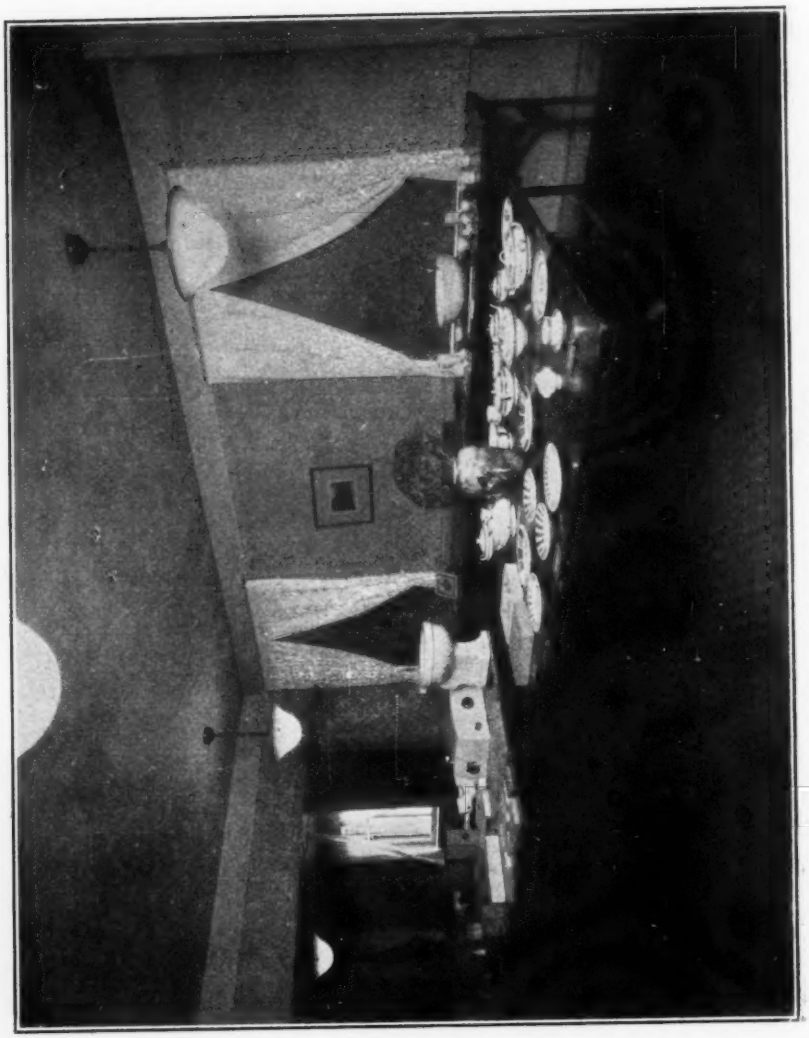


FIG. 4.—White Ware Exhibit.

glazes, and also a series of glaze experiments. In connection with the latter, it is hoped that other schools will follow this example and exhibit experimental work.

The St. Louis Grade Schools sent a small group of hand built vases and flower holders.

Miss Mabel C. Farren, formerly instructor in pottery in the Carnegie Institute of Technology, Pittsburgh, exhibited a series of photographs of pottery made by the students under her direction.

### Art Potteries

The Rookwood Pottery exhibited a beautiful group of vases showing various developments during the later years of their activity. In this group were examples of their famous "Tiger Eye" glaze, their exquisitely executed slip decorations, and a very handsome rose jar of Chinese type.

Fulper Pottery was represented by a group of vases in stoneware, or Gres, finished in mirror black, matte and enamel glazes.

Newcomb College, New Orleans, sent a group of vases and bowls finished in nicely balanced harmonies of greens and blues. Newcomb Pottery, with its well-designed woodland decorations, is one of the few distinctive American Potteries.

Other potteries exhibiting were The Paul Revere Pottery, Boston, Mass., showing examples of their well-known nursery utilitarian ware, and S. A. Weller of Zanesville, Ohio, who sent a wide range of ornamental pottery, including lustres, matte glazes, enamels, modeled birds, etc.

### Studio and Individual Potters

The most noticeable impression received by the follower of the Arts and Crafts movement when viewing such a ceramic exhibition as the one under discussion is of realization that the American potter is surely and definitely becoming master of his craft.

Both in the schools and in the small studio potteries, the technique and execution has developed to a standard far ahead of that of the studio clayworker of ten, or even five years ago. In fact, the craft has already advanced to a stage where it is possible to name from a dozen to twenty schools and individual potters who can show the products of their kilns side by side with the work of European potters of high reputation without suffering in comparison.

The credit for this development naturally belongs to the schools; and, because these schools are giving due attention to such important factors as workmanship, execution, technique, or all those conditions that contribute to what is good in potting, the various manufacturers, and others who are actively interested in the higher development of the industry, can not do better than to use every available means to encourage and support the schools in the work they are doing.

List of exhibits of individual potters: Professor C. F. Binns, Director of the New York State School of Clayworking, had a case of very beautiful stoneware vases and bowls. One piece, a gourd or bottle-shaped vase, is fine enough to find a place in any museum among a collection of American contemporary art.

Arthur E. Baggs, Marblehead, Mass., had two most attractive and skilfully executed jardinières. Russell G. Crook, South Lincoln, Mass., sent two stoneware vases with cleverly designed animal motifs. Mrs. Frederick H. Rhead sent a series of porcelain panels with Pate-sur-pate figure decorations; the Misses Overbeck, Cambridge City, Indiana, exhibited a variety of shapes very prettily decorated and executed. Miss Mabel C. Farren, Pittsburgh, Pa., sent a series of earthenware and porcelain dinner plates decorated with liquid underglaze colors. Bertha Riblet Pire, Cleveland, Ohio, sent some very attractive tile. Mr. B. S. Radcliff and Mr. L. A. Behrendt, St. Louis, had a pair of chrome-tin pink enamels, and Mrs. Mary Chase Stratton of the Pewabic Pottery, Detroit, sent a group of tile and vases finished in enamels and lustre, all most charming in color and texture.

A case of cabinet pieces, showing examples of Sung, K' ang-shi, Chenlung, and also some Japanese porcelains of the old school, from the collection of F. H. Rhead were used for reference purposes during various process discussions.

### Glass Division

The Glass Division was represented by H. C. Fry Company, of Rochester, N. Y., with examples of cut glass, baking wares and some very attractive utilitarian articles.

### White Ware Division

This Division was represented by the Knowles, Taylor and Knowles Co., East Liverpool, Ohio, Hercules China Co., Sebring Pottery Co., Sebring, Ohio, Homer Laughlin China Co., Newell, W. Va., Edwin Knowles Co., East Liverpool, Ohio. The Universal Sanitary Manufacturing Company of Newcastle, Pa., sent three examples of their cast sanitary ware. One of these pieces was in cross section showing the even thickness all through the piece when made by the cast process. The Coors Porcelain Co., of Golden, Colorado, had a comprehensive exhibit of chemical porcelain. The General Electric Company, Schenectady, N. Y., The Lapp Insulator Co., LeRoy, N. Y., and the Jeffery-DeWitt Insulator Company, Kenova, W. Va., exhibited examples of various types of porcelain insulators.

A series of plates showing various ceramic colors was shown by the Roessler-Hasslacher Company, New York. The examples of porcelain doll heads made by the Fulper Pottery Company, Flemington, N. J., should also be included in the white ware group.

### Terra Cotta Division

FAIENCE AND TERRA COTTA WARES

The following concerns sent examples of architectural faience and terra cotta: The Northwestern Terra Cotta Company, Chicago, Ill.; O. W. Ketcham Terra Cotta Company, Crum Lynn, Pa.; American Terra Cotta Company, Chicago, Ill.; St. Louis Terra Cotta Company, St. Louis, Mo.; The Conkling Armstrong Company, Philadelphia, Pa.; The Rookwood Pottery Company, Cincinnati, Ohio; and The Flint Faience Tile Company, Flint, Mich.

Conrad Dressler sent a series of photographs of bas-relief panels, a bust in terra cotta of Philip Dressler, and a very beautiful sketch medallion finished in blue and green transparent glazes.

### Refractories

The Refractory Division was represented by The Norton Company, Worcester, Mass.; The Carborundum Company, Perth Amboy, New Jersey; The Mitchell Clay Manufacturing Company, St. Louis, Mo.; and the Laclede-Christy Clay Products Company, St. Louis, Mo.

### Stoneware

The Maurice Knight Company of Akron, Ohio, sent a number of examples of acid-proof chemical stoneware.

## PROPHETIC COST ACCOUNTING

By G. W. Greenwood

The ultimate aim of the American Ceramic Society is to increase human happiness. With building materials of clay, man possesses a more beautiful and a more comfortable home; by pottery and other objects of ceramic art it is furnished and made more attractive; a brick road leads to it; by tile, his land is drained, and refractories play their part in the production of everything in the manufacture of which fire has been employed.

This Society affords each member an opportunity of understanding better the part performed by others in this pursuit of the common welfare, and, by their sympathetic coöperation, its members help one another.

The importance of this harmonizing and illuminating influence, as here exhibited, becomes more fully realized when one sees the indifference, even the antipathy, of men engaged in different phases of the same, or kindred, subjects, as in pure and applied science, research and practical operation.

Too often practical men, without whose services we would starve, are not in sympathy with research, without which we would have no progress. For instance, a practical man might ask the use of the chemistry of the

stars, yet helium, named for the place of its discovery, was first found on the sun, thus outdoing Baron Munchausen whose hatchet, altho found on the moon, had been previously lost on the earth. That the propagation of yellow fever is through the bill of a mosquito of a certain species, which a certain number of days before has bitten another victim, is a discovery which justifies all the time spent in studying the habits of insects. When Pasteur first contemplated the study of spontaneous generation, his friends attempted to dissuade him from wasting his time on that barren subject, and yet modern surgery is but one of the results. Kepler studied astronomy, giving the world the three laws which bear his name, laying the foundations upon which Sir Isaac Newton builded, but he practiced astrology on the side to pay expenses. The Curies, when they started out to track radium to its lair, little suspected, as we indeed little suspect now, the future possible applications of this element. Research is like the leaden casket which promises nothing but which pays the best.

On the other hand, however, men intent upon scientific pursuits too often care naught for the possible benefits therefrom: Gauss, the mathematician, thanked God for the theory of numbers, because it was a branch of mathematics which could not possibly be put to any practical use.

But while pure and applied investigators find here in this Society a meeting place, a common forum, there is yet one science for which neither faction has much, if any, respect. And that is Cost Accounting.

Practical men see in it no promise of profit, and the research investigator sees in it no promise of hidden truth. Both are sadly mistaken. The accountant is viewed as one who merely juggles figures, making different combinations, but unable to alter their total. For instance, the writer has been asked, "What difference does it make anyway? Whatever system is used, you have no more money in the bank."

And of ordinary, post mortem cost accounting, this may indeed be true, for instead of dealing with live problems, the accountant too often spends most of one month embalming and wrapping in red tape results which expired the last day of the previous month.

This is what I mean by post mortem accounting: About the twentieth of the month, the bookkeeper presents the management with a statement of the operating and other expenses for the previous month, each element being divided by the output (or by some other factor).

Instead of entering into a critical discussion of this process, since this is not a meeting of accountants, consider the following illustration: Suppose one were to take daily readings for a month of the temperature of all kilns under fire, add these temperatures, and divide by the total number of readings, presenting this average to the manager about the twentieth of the following month. Of what use would this average be in controlling current kiln temperatures? Or, suppose on going to the ticket agent for infor-

mation concerning trains to St. Louis, with a view to attending a meeting of the American Ceramic Society, the agent were to tell you that, instead of advance information as to the movement of trains, he had on file only the result of the movement of trains during the previous month: and that this result was found by taking the time of all trains between Pittsburgh and St. Louis, freight and passenger, express and local, and dividing the total time by the number of trains which started from Pittsburgh during the month. Of what use would this information be to you?

I can see no difference between these hypothetical cases and the actual case of a manager wishing to know the cost of certain fire clay shapes which he proposes to make the following week, but who is offered instead the result of taking the charges for the previous month and dividing by the nine-inch equivalent of all brick and shapes, hand made and machine, standard and special, easy and difficult, which were molded.

We are told, authoritatively, that considerably less than ten per cent of the country's industries have a cost system. But if we define cost finding as *the elimination of waste and the reduction of costs by means of modern accounting methods*, then the number having cost systems will shrink to an alarming extent.

The principles underlying scientific accounting are the same as those for any other science and they are already recognized, and employed, by this Society. Therefore this Society can give a decided impetus to actual, constructive cost accounting.

The first element in a successful system of accounting is *predetermination*. But here again, let us draw our illustrations from familiar sources. To the ancients, there existed seven heavenly bodies: the Sun, the Moon, Mercury, Venus, Mars, Jupiter, Saturn, a complete, a perfect number, known to man as far back as written records extend. That there might be another planet was beyond the scope of one's imagination. Then, by chance, using his home-made telescope, Herschel discovered a new planet which was named Uranus. Years later a mathematician sent an astronomer word to turn his telescope to a certain part of the heavens and to look for a new planet. And thus was Neptune found by calculation before it was seen. How? By the fact that the movement of Uranus was predicated, but that it did not conform to the path worked out for it.

The discovery of the telescope was soon followed by the discovery of four moons of Jupiter. Their eclipses were observed, and future eclipses predicted. But future eclipses failed to occur on schedule time. At one time they would be punctual, several months later they would be behind hand, then again they would conform to the forecast. From this discrepancy came the discovery of the velocity of light, which up to that time had been thought to be instantaneous. From this also is derived a relationship between light and electricity, and from it the Einstein theory has been

evolved. From a study of the properties of chemical elements, the existence of new, and as yet undiscovered, elements was successfully predicated and the properties foretold.

These illustrations could be multiplied. But the lesson they all teach is this: If one merely recorded the past, and did not forecast the future, what progress would there be? Aside from that which comes by accident, most progress results from prediction followed either by verification confirming our hypotheses to this extent, or by discrepancies which lead to investigation and new discoveries.

It is the business of science to *predict*. It is the business of a scientific cost system to *predict costs*, and then either to confirm the prediction or to investigate the discrepancies. *A cost system, to be profitable, must be prophetic.*

To you, of course, this presentation is not new. Prophecy is ingrained in your methods of operation. It is only the cost department which lives in the past. I trust that upon your return to your labors, you will say something like this to your accounting departments: "We lay out in advance, a running schedule. We plan to make a product of a specified size, shape, or color; to stand up under a certain fusion test, or under a specified rattler test. We plot before it is fired the curve to which the temperature of a kiln should conform. We make promises of future delivery of material. We have a definite time to start the day's work, and a standard turn per day. We know what each machine is supposed to turn out per hour. We have an hourly wage, and an established salary list. Everything possible is predicted, and performances are checked up against predictions. *We expect you to take this same course in your accounting.*"

## ACTIVITIES OF THE SOCIETY

### Annual Tables of Constants and Numerical Data

#### Physical, Chemical and Technological

The confederation of French scientific societies has renewed for the year 1922 its contribution of 40,000 francs in support of Annual Tables. The total subscription in France to this project during the year 1921 was 80,000 francs.

At the approaching meeting of the International Union of Pure and Applied Chemistry which is to be held at Lyons in June, the matter of organizing the work of Annual Tables upon a solid financial basis will come up for consideration. This important international project has had a very precarious existence since 1914 and the fact that the work has been continued at all has been due to the efforts of the General Secretary, Dr. Charles Marie.

Plans for providing a certain and sufficient budget for the work during the next five years are in preparation, based upon definite annual contributions from the various countries in the International Union.

It is announced that the National Research Council of Japan has appointed the following Advisory Committee for Annual Tables:

| | | | |
|---|---|---|---|
| Yasuhiko Asahina | (Tokyo) | Seiji Nakamura | (Tokyo) |
| Eiji Aoyagi | (Kyoto) | Kyoji Suyehiro | (Tokyo) |
| Kotaro Honda | (Tohoku) | Umetaro Suzuki | (Tokyo) |
| Katsuji Inouye | (Tohoku) | Takuro Tamaru | (Tokyo) |
| Gen-itsu Kita | (Kyoto) | Mitsumaru Tsujimoto | (Tokyo) |
| Koichi Matsubara | (Tokyo) | Nobuji Yamaga | (Tokyo) |
| Tsuruzo Matsumura | (Kyoto) | Noboru Yamaguti | (Tokyo) |

The Chairman of the Committee is Professor Yukichi Osaka, Japanese member of the International Commission in charge of Annual Tables.

The American Ceramic Society contributes to the support of this great coöperative enterprise.

## Report of Annual Meeting of White Wares Division

It affords me great pleasure to inform you that the annual meeting of the White Wares Division was a great success, both from the standpoint of attendance and from the number and character of papers contributed.

At the business meeting, the by-laws recommended by the Rules Committee for use in the several divisions were adopted in their entirety.

The following officers were elected for the year 1922:

Chairman—Samuel B. Larkin,
National China Co., Salineville, Ohio.

Secretary—C. C. Treischel,
General Electric Co., Schenectady, N. Y.

Chairman Research Committee—F. K. Pence,
Knowles, Taylor & Knowles, East Liverpool, O.

Chairman Rules Committee—August Staudt,
Perth Amboy Tile Works, Perth Amboy, N. J.

Chairman Membership Committee—Ira E. Sproat,
Mahoning Clay Company, Sebring, O.

Chairman Nominating Committee—Mr. Herbert E. Goodwin,
Crescent China Co., Niles, O.

Chairman Standards Committee—H. Spurrier,
Square D Company, Peru, Ind.

The White Wares Division representative on the Coördinating Service Council will be as follows:

Committee on Research—F. K. Pence.

Committee on Standards:

(*a*) Standardization of Tests, F. S. Hunt.

(*b*) Standardization of Products, H. Spurrier.

Committee on Data—C. C. Treischel.

Out of a total of 22 listed papers and colloquiums, 18 were presented at the Divisional meeting.

The Division, by a unanimous vote, adopted a resolution to carry a coöperative investigation of the sagger problem, as affecting the White Wares Industry. This problem will, no doubt, be taken care of within the near future by the Research Committee.

CHESTER TREISCHEL, *Secretary*,
White Wares Division

## Minutes of the Fourth Annual Meeting of the Glass Division of the American Ceramic Society

Hotel Statler, St. Louis, Mo., Feb. 28, 1922.

The meeting was called to order by Vice-President J. C. Hostetter, J. H. Forsyth acting as Secretary. The following papers were read:

The Passing of King Methane, S. R. Scholes (read by W. A. Yung).

Reports on Tentative Standards of Glass House Refractories and on Lime, A. Silverman (read by D. W. Ross).

A Note on the Effect on Manganese in Glass of Melting at Reduced Pressure, E. N. Bunting.

Operation of Leers, C. E. Frazier.

After adjournment for lunch the reading of papers was continued.

A Small Glass Tank, H. T. Bellamy.

The Handling, Storing and Setting of Glass Pots, Wm. M. Clark and J. H. Forsyth.

Physical Defects in Tank Blocks, G. A. Loomis.

Disintegrating Action of Water on Soda Lime Glass, A. E. Williams.

Evolution and Development of Glass House Equipment, J. S. Herzog.

The meeting was again called to order on Wednesday, March 1st at nine-thirty A.M.

This session commenced with a discussion of tentative specifications for Glass House Refractories. It was voted that "The Report of this Committee as such, be not accepted as tentative specifications for refractories and that it be referred back to the Committee on Standards and that said committee consult with a committee appointed from the Refractories Division and the two committees consult with committee C-8 of A. S. T. M."

After discussing the "Tentative Specifications for Lime in Glassmaking" it was voted *to adopt the specifications as tentative.*

The colloquium topics were then taken up and resulted in a lively and interesting discussion. Indeed the entire meeting was characterized by free and lively discussions.

The following officers were elected for the ensuing year.

| | |
|---|---|
| *Chairman* | J. C. Hostetter |
| *Vice-Chairman* | A. R. Payne |
| *Secretary* | A. E. Williams |
| *Councillors* | H. W. Hess |
| | J. W. Wright |

It was voted that the Chairman be given instructions and power to appoint all committees.

E. WARD TILLOTSON, *Secretary*

## NEW MEMBERS RECEIVED SINCE FEBRUARY 20, 1922

ASSOCIATE

**Abbott, Harold W.,** St. Marys, Pa., Carbon Division, Stackpole Carbon Co.

**Adams, C. C.,** Latrobe, Pa., Sec.-Treas., Conemaugh Iron Works Co.

**Adams, Samuel P.,** 29 S. LaSalle St., Chicago, Ill., Ashland Fire Brick Co.

**Adderley, James R.,** 50 Lower Potter St., Brierley Hill, S. Staffs., England, Chemist, E. J. & J. Pearson Ltd.

**Aichele, Albert E.,** 524 Orchard Ave., Cambridge, Ohio.

**Anderle, Emil J.,** 132 E. Hudson Ave., Dayton, Ohio, International Clay Machinery Co.

**Beebe, Daniel S.,** Chamber of Commerce Bldg., Chicago, Ill., Vice-Pres., Treas. and Gen. Mgr., The Vitrolite Co.

**Birner, William,** Box 139, R. R. No. 1, East San Gabriel, Cal., Washington Iron Works.

**Bittner, A. G.,** Central Sta., Box 1400, St. Louis, Mo., Factory Supt., National Enameling and Stamping Co.

**Black, Percy C.,** Amherst, Nova Scotia, Pres., Nova Scotia Clay Works Ltd.

**Breese, A. G. C.,** 344 N. Pearl St., Bridgeton, N. J., Furnace Foreman, Illinois Glass Co.

**Burt, P. E.,** Box 1026, Huntington, W. Va., Saks Stamping Co.

**Busch, Albert D.,** 5379 Pershing Ave., St. Louis, Mo., The W. S. Tyler Co.

**Bussell, William T.,** Brazil, Ind., Plant Supt., The Clay Products Co.

**Butterfield, Fred H.,** 4906 McPherson Ave., St. Louis, Mo., Plant Mgr., Crunden Martin Mfg. Co.

**Caven, Trevor M.,** 26 Cortlandt St., New York City, Consulting Engineer, Quigley Furnace Specialties Co.

**Conard, John B.,** 91 W. Third Ave., Mansfield, Ohio, Supt., Richland Shale and Brick Co.

**Condit, Leo B.,** 23 N. Lotus Ave., Chicago, Ill.

**Cossette, Louis J.,** 1821 Vernon St., N. W., Washington, D. C., U. S. Bureau of Standards

**Craig, Robert H.,** 15607 Loomis Ave., Harvey, Ill., George M. Clark & Co.

**Dandurand, Raymond A.,** Brazil, Ind., Sec., The Clay Products Co.

**Dedouch, J. A.,** 611 S. Elmwood Ave., Oak Park, Ill., Mgr., Imperishable Miniatures Co.

**Duty, S. M.,** 4900 Euclid Ave., Cleveland, Ohio, Pres. and Treas., The Medal Paving Brick Co.

**Elsenius, Charles A.,** 1631 Woolsey St., Berkeley, Cal.

**Ford, Karl L.,** 3555 Eleventh St., N. W., Washington, D. C., U. S. Bureau of Standards

**Frank, G. Harry,** 3328 Monroe St., Chicago, Ill., The Meyercord Co.

**Geuder, George,** 38 Fifteenth St., Milwaukee, Wis.

**Hazelwood, Fred,** 310 R St., N. E., Washington, D. C.

**Heinz, George P.,** 1740 Champa St., Denver, Colo., The Heinz Roofing Tile Co.

**Herzog, John S.,** Newark, Ohio, Gen. Mgr., The Simpson Foundry and Engineering Co.

**Holbert, John S.,** 7349 N. Paulina St., Chicago, Ill., Dist. Mgr., Hardinge Co.

**Hollowell, R. D. T.,** 110 S. Dearborn St., Chicago, Ill., Sec., American Face Brick Association.

**Holman, Harry B.,** 1017 Olive St., St. Louis, Mo., Mgr., Industrial Division, Commercial Dept., Laclede Gas Light Co.

**Ivery, Sidney H.,** 4432 Gibson Ave., St. Louis, Mo., Enamel Plant Supt., Hydraulic Press Brick Co.

**Jeffery, L. Edson,** Detroit, Mich., Champion Porcelain Co.

**Johnson, Joseph,** Trenton, N. J., Chemist, Research Division, Trenton Potteries Co.

**Jones, John E.,** 28 Vine St., Trenton, N. J., Trenton Potteries Co.

**Jones, Walter A.,** 50 Third St., Columbus, Ohio, Pres., W. R. Jones & Co.

**Kahn, Bertrand B.,** Hamilton, Ohio, Sec. and Gen. Works Mgr., Estate Stove Co.

**Kneisel, Carl F.,** Box 732, Sheridan, Wyo., Sec.-Treas. and Mgr., Sheridan Press Brick and Tile Co.

**Lasley, Marshall,** 801 Volunteer Bldg., Chattanooga, Tenn., Vice-Pres., Southern Clay Mfg. Co.

**Lawrence, George J.,** 7709 S. Morgan St., Chicago, Ill., The J. B. Ford Co.

**Leyerle, Arthur R.,** 3595 W. 47th St., Cleveland, Ohio, Vitreous Enameling Co.

**Lindsay, R. D.,** W. 16th Ave. and Clay St., Denver, Colo., Supt., The Denver Pressed Brick Co.

**Lippert, Walter T.,** 1322 Broadway, Alton, Ill., Illinois Glass Co.

**Llige y Pages, Juan,** 304 Consejo de Ciento St., Barcelona, Spain

**Lockwood, L. J.,** 106 Hampton St., Bridgeton, N. J., Illinois Glass Co.

**McGean, Ralph L.,** 545 Hanna Bldg., Cleveland, Ohio, Harshaw, Fuller & Goodwin Co.

**Mahoney, Frank B.,** Chattanooga, Tenn., Asst. Supt., Crane Enamel Ware Co.

**Marsh, Charles M.,** Illinois Glass Co., Bridgeton, N. J., Gen. Supt., Cumberland Plants
**Meissner, Max,** 201 Chestnut St., Hoopeston, Ill., Sprague Canning Machine Co.
**Millar, James B.,** Box 248, Poteau, Okla., Treas., Athletic Mining and Smelting Co.
**Mills, Harry R.,** 255 N. Hoyne Ave., Chicago, Ill., L. W. Wolff Mfg. Co.
**Moellering, Walter S.,** 414 Montgomery St., Fort Wayne, Ind., Mgr. of Sales Promotion, William Moellering's Sons.
**Morris, Bert W.,** 5049 Murdock Ave., St. Louis, Mo., Supt., Parker Russell Mining and Mfg. Co.
**Nelson, L. C.,** Peru, Kansas, Mgr., Mid-Continent Clay Co.
**Nickerson, F. P.,** 8100 Broadway, Cleveland, Ohio, Engineer, The W. S. Tyler Co.
**Niegsch, Paul H.,** Scranton, Pa., Scranton Enameling Co.
**Oberlin, John F.,** 1021 Society for Savings, Cleveland, Ohio
**Redrow, Walter L.,** 3533 Thirteenth St., N. W., Washington, D. C., U. S. Patent Office
**Reed, Robt. R.,** Rockefeller Hall, Ithaca, N. Y.
**Renkert, Oliver W.,** Canton, Ohio, Vice-Pres. and Gen. Mgr., Metropolitan Paving Brick Co.
**Riddell, Wallace C.,** 1429 LeRoy Ave., Berkeley, Cal., Chemical Engineer
**Roth, H. A.,** 463 East 28th St., Brooklyn, N. Y., Lalance & Grosjean Mfg. Co.
**Schreiber, George L.,** Box 265, Santa Monica, Cal.
**Seelig, Albert F.,** 2193 Railway Exchange Bldg., St. Louis, Mo., Industrial Furnace Engineer
**Sharkey, Samuel M.,** Trenton, N. J., Asst. Supt., B. O. T. Mfg. Co.
**Sheffield, Albert H.,** 1701 Prairie Ave., Chicago, Ill., American Terra Cotta & Ceramic Co.
**Skinner, Ramsey,** 4471 Olive St., St. Louis, Mo., Treas., Reeves & Skinner Machinery Co.
**Stover, J. Homer,** 176 Grant Ave., Nutley, N. J., Sales Mgr., John Johnson Co.
**Stratton, Mrs. W. B.,** 10125 Jefferson, E., Detroit, Mich., Pewabic Pottery
**Sulliva, Willard P.,** 110 West Plume St., Norfolk, Va., Nansemond Brick Corp.
**Thomas, James R.,** Crawfordsville, Ind., Standard Brick Co.
**Varney, William P.,** 133 West Washington St., Chicago, Ill., Hydraulic Press Brick Co.
**Vincent, Lawrence A.,** 1740 East 12th St., Cleveland, Ohio, American Dressler Tunnel Kilns, Inc.
**Wachovec, Peter,** 2463 E. 84th St., Cleveland, Ohio, Vitreous Enameling Co.
**Waggoner, Chauncey W.,** 730 University Terrace, Morgantown, W. Va., Professor of Physics, University of West Virginia
**Widemann, R. V.,** 32 rue de la Grange aux Belles, Paris, France
**Wikoff, Alan G.,** 1570 Old Colony Bldg., Chicago, Ill., Industrial Editor, *Chemical and Metallurgical Engineering*
**Wilkes, Gordon B.,** Massachusetts Institute of Technology, Cambridge, Mass., Asst. Professor of Industrial Physics
**Zur Horst, Herbert H.,** 1463 Greenmont Ave., Dormont, Pa., Ceramist, Vitro Mfg. Co.

CORPORATION

**American Trona Corporation,** 233 Broadway, New York City
**Claycraft Mining and Brick Company,** 907 Hartman Bldg., Columbus, Ohio
**Electric Porcelain and Manufacturing Company,** Trenton, N. J.
**Eureka Flint and Spar Company,** Trenton, N. J.
**Hazel-Atlas Glass Company,** Wheeling, W. Va.
**Huntington Tumbler Company,** Huntington, W. Va.
**Millville Bottle Works,** Millville, N. J.
**Pass & Seymour, Inc.,** Solvay, N. Y.

**Schaffer Engineering and Equipment Company,** 2828 Smallman St., Pittsburgh, Pa.
**Standard Sanitary Mfg. Co., Tiffin Works,** Tiffin, Ohio

## Play Ball

Ninety-nine new members between February 20 and March 30! This averages 25% more than the record for December, January and the first part of February. The reason for this gain is that forty-five members have been at bat, and ten of these have been up more than once. A. B. Christopher has a wicked wallop with four hits to his credit; C. H. Modes, Geo. W. Shoemaker, and D. F. Stevens each pounded the pill three times; while Ed. Brockman, L. J. Frost, James Hamilton, R. D. Landrum, F. H. Riddle and E. W. Washburn each put it over twice. Those in the one-hit column are as follows: H. C. Arnold, Davis Brown, G. H. Brown, W. F. Brown, Horace H. Clark, R. R. Danielson, W. E. Dornbach, Philip Dressler, O. V. Earl, W. J. Frey, Donald H. Fuller, Wm. D. Gates, S. Geijsbeek, M. B. Greenough, Chester H. Jones, J. T. Keenan, I. A. Krusen, R. H. McElroy, P. S. MacMichael, H. J. Mauschbaugh, G. F. Metz, Edward Orton, Jr., Wiley T. Rabun, B. S. Radcliffe, H. Ries, H. H. Sortwell, Stockton Fire Brick Company, C. W. Thomas, Leo Thürlimann, Karl Türk, S. F. Walton, Wm. W. Wilkins. Corporation Members were secured by G. C. Kalbfleisch, F. G. Lord, and Karl Türk. Members obtained through the Secretary's office, which are not included above, bring the total to eighty-one Associate and ten Corporation memberships.

This is the kind of work that counts. If forty-five *more* members will enter into the game this month, there ought to be another increase of 25%. Do you want to send a sample copy of the *Journal*, or material descriptive of the Society, to a "Prospect?" Let the office of the Secretary help you.

## Your Dues are Paid

If they were not, you would not have received this number of the *Journal*. If the other fellow in your department has not received his copy, ask him if his dues are paid. He may be one of the three hundred members who have not paid for 1922. This means that he will not receive the April and subsequent numbers of the *Journal* until he pays up. We do not like to cut his name off the mailing list but postal regulations demand it. The missing numbers will be supplied when he "comes across," but it will not be much fun for him to get nine numbers of the *Journal* all at once next December. Tell him to take the price of two seats at a Shakespearian play, which he would not go to anyway, and send it to us now. Everybody has $7.50 the first week in the month.

## WHO'S WHERE IN THE AMERICAN CERAMIC SOCIETY

**Gail Truman** has gone to Glendale, Cal., where he will be associated with **F. B. Ortman** at the Tropico Potteries, Inc. **B. S. Radcliffe,** formerly of Des Plaines, Ill., takes Mr. Truman's place at the St. Louis Terra Cotta Co.

**Leon J. Frost,** lately connected with the Phillips & Clark Stove Co., Geneva, N. Y., has returned to Cleveland, Ohio, to be with the Vitreous Enameling Co., of which **R. D. Landrum** is now vice-president.

**George A. Loomis,** lately with the Bureau of Standards, is with the Ohio Valley Clay Co., at Steubenville, Ohio.

**L. H. Hart,** after some time as manager of the Construction Department of the National Lime Association, has established "Building Lime Service" at Buffalo, N. Y.

**E. F. Theobald** has recently taken a position with the Metropolitan Paving Brick Co., at Canton, Ohio.

**J. A. Nagle** was in the office of the General Secretary recently, having taken up his residence in Columbus, as representative of the Pittsburgh China Co.

**F. K. Pence,** President of the American Ceramic Society during 1921, has been with Knowles, Taylor & Knowles, of East Liverpool, since January first.

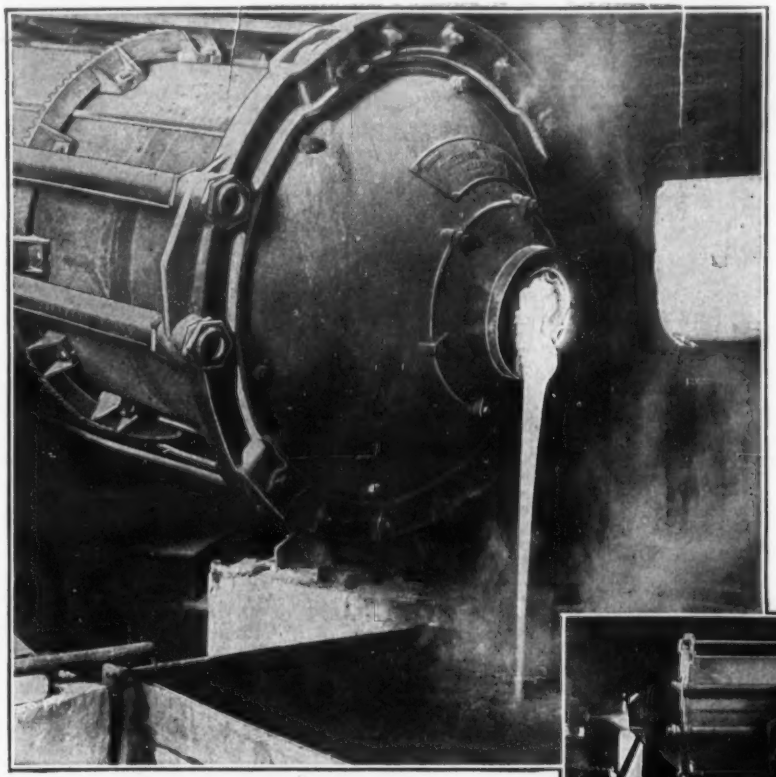
## NECROLOGY

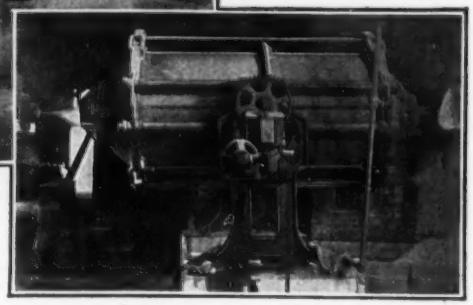
**Merritt Brooke Cheney** was born in Mechanicsburg, Ohio, June 30, 1886, and died at Grant Hospital, Columbus, Ohio, on December 24, 1921, after an illness of eleven days. Mr. Cheney was graduated from Ohio State University in the Department of Ceramics in 1909. For seven years he engaged in consulting ceramic engineering work, the last four years of this time at Inglewood, Ontario, where he built and operated a plant successfully until the war necessitated shutting down and Mr. Cheney returned to the States. He was commissioned as First Lieutenant in the Chemical War Service and worked at Cleveland and Zanesville on charcoal for gas masks. His discharge from the army did not come until April, 1919, when he, with Capt. Barneby, formed the Barneby-Cheney Engineering Company, at Columbus. Plans were being made for a new plant at the time of Mr. Cheney's death. He is survived by his wife and three sons, to whom the sympathy of his friends in the American Ceramic Society is extended.

**Thomas L. Strong,** born in Frankfort County, Kansas, April 27, 1866, died at his home in Coshocton, Ohio, September 5, 1921. He began his business career in early life, being associated with the Novelty Stamping Company of Bellaire, Ohio, and a little later with the Enterprise Stamping & Enameling Company, of the same city. In 1903 he organized The Strong Enameling Company, which was later changed to Strong-Batelle Mfg. Co., and 1909 the name was again changed to The Strong Mfg. Co. In 1912 a new plant was built at Sebring, O. Owing to ill health he retired from business in the spring of 1919 and located at Coshocton, O.

A few months later, seeming to have recovered from his breakdown, he became interested in the Lafayette Stamping & Enameling Company of West Lafayette, Ohio. There was a recurrence of his trouble, and he was obliged to retire from business again.

He was a man of strong Christian character; a hard and consistent worker and a close student of business and economic conditions; sharing with his employees the profits of his business. His sterling character and congenial good nature won for him the love and esteem of all who knew him.





*These illustrations made from photographs taken in the plant of Ingram-Richardson Mfg. Co., Beaver Falls, Pa.*

12-21

# "Our U. S. Enamel Furnaces Increase Output 25% per day at a Saving of 50% in Fuel Cost."

Ingram-Richardson Mfg. Company claim those remarkable results for their U. S. Enamel Furnaces. With four U. S. Furnaces operating at their plants at Frankfort, Indiana, and Beaver Falls, Pa., they are saving thousands of dollars yearly in fuel and labor.

Their white and colored enamels are smelted in quick time, with low loss. The work is easy and sure. The Furnace is under perfect scientific control. The melting process is visible. The Furnace rotates while melting and tilts when pouring. Linings last longer and cost less.

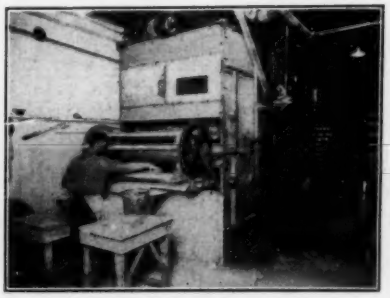
The U. S. Enamel Furnace is saving money over the old brick smelter in the Ingram-Richardson Mfg. Company plant. It will do the same for you.

## Let the U. S. Furnace melt your enamel.

Write for specifications and prices on 60 lb., 150 lb., 400 lb., 750 lb., and 1200 lb. Enamel Furnaces. We will send photographs and list of users where furnaces are in operation.

**THE**
**U. S. SMELTING FURNACE CO.**
**BELLEVILLE, ILLINOIS**

# Better Drying for Dipped Ware



"Proctor" Automatic Mangle—type for one dipper. One of four at Shenango Pottery Co., New Castle, Pa.

"Proctor" Automatic Mangle—type for two dippers. One of two at Sebring Pottery Co., Sebring, Ohio.

## The "Proctor" Automatic Mangle

Makers of General Ware who use "Proctor" Automatic Mangles will tell you these machines have improved their dipping results wonderfully.

The ware is dried uniformly and perfectly. It always has that firm surface which best resists scarring. There's no finger-marking or rubbing.

The Sebring Pottery Co., one of the enthusiastic users, recently wrote us: "We believe we will save each year in improved quality, many times the original cost."

This mangle makes dipping and drying a rapid, continuous process. Moving shelves receive the ware directly from the dipper and deliver it at the opposite end, within a surprisingly few minutes, dried perfectly.

An enormous output is obtained at great savings of time, space and labor.

## PROCTOR & SCHWARTZ, Inc.

PHILADELPHIA, PA.

"Proctor" DRYERS

## BUYERS' GUIDE

**Alumina** (Hydrate and Calcined)
Pennsylvania Salt Mfg. Co.

**Auger Machines**
Chambers Brothers Co.
Crossley Machine Co.
Manufacturers Equipment Co.

**Automatic Cutters**
Chambers Brothers Co.

**Automatic Stove Rooms**
Philadelphia Drying Mch. Co.

**Ball Mills**
Crossley Machine Co.
Hardinge Co.
Mueller Machine Co., Inc.

**Bituminous Coal**
Seaboard Fuel Corp.

**Boilers**
Nashville Industrial Corp.

**Brick Making Machinery**
Chambers Brothers Co.

**Business Education**
Alexander Hamilton Institute

**Caustic Soda**
Pennsylvania Salt Mfg. Co.

**Ceramic Plant Equipment**
Chambers Brothers Co.
Crossley Machine Co.
Manufacturers Equipment Co.
Mueller Machine Co., Inc.
Philadelphia Drying Machinery Co.
Proctor and Schwartz, Inc.

**Ceramic Chemicals**
Drakenfeld Co., B. F.
Harshaw, Fuller and Goodwin Co.
Paper Makers Importing Co., (Inc.)
Roessler and Hasslacher Chemical Co.
Vitro Mfg. Co.

**Clay** (Abrasives)
Old Hickory Clay & Talc Co.

**Clay** (Ball)
Johnson Porter Clay Co.
Old Hickory Clay & Talc Co.
Potters Supply Co., The

**Clay** (China)
Edgar Brothers Co.
Drakenfeld and Co., B. F.
Old Hickory Clay & Talc Co.
Paper Makers Importing Co., (Inc.)
Roessler & Hasslacher Chemical Co.

**Clay** (Electrical —Porcelain)
Edgar Brothers Co.
Johnson Porter Clay Co.
Old Hickory Clay & Talc Co.
Paper Makers Importing Co., (Inc.)

**Clay** (Enamel)
Edgar Brothers Co.
Johnson-Porter Clay Co.
Old Hickory Clay & Talc Co.

**Clay** (Fire)
Edgar Brothers Co.
Old Hickory Clay & Talc Co.
Paper Makers Importing Co., (Inc.)

**Clay** (Potters)
Johnson-Porter Clay Co.
Old Hickory Clay & Talc Co.

**Clay** (Sagger)
Edgar Brothers Co.
Johnson Porter Clay Co.
Old Hickory Clay & Talc Co.
Paper Makers Importing Co., (Inc.)
Potters Supply Co., The

**Clay Handling Machinery**
Crossley Machine Co.
Hadfield-Penfield Steel Co.
Manufacturers Equipment Co.
Mueller Machine Co., Inc.

**Clay Miners**
Edgar Brothers Co.
Johnson Porter Clay Co.
Old Hickory Clay & Talc Co.

**Clay** (Wall Tile)
Old Hickory Clay & Talc Co.

**Clay Washing Machinery**
Crossley Machine Co.
Mueller Machine Co., Inc.

**Clay Working Machinery**
Crossley Machine Co.
Hadfield-Penfield Steel Co.
Manufacturers Equipment Co.
Mueller Machine Co., Inc.

**Coal-(Bituminous)—**
Seaboard Fuel Corp.

**Colors**
Drakenfeld and Co., B. F.
Harshaw, Fuller and Goodwin Co.
Roessler and Hasslacher Chemical Co.
Vitro Mfg. Co.

**Conditioning Machinery**
Philadelphia Drying Machinery Co.

**Conical Mills**
Hardinge Co.

**Conveyors** (Clay, Sand, Brick, etc.)
Crossley Machine Co.
Hadfield-Penfield Steel Co.
Philadelphia Drying Machinery Co.
Manufacturers Equipment Co.
Mueller Machine Co., Inc.

**Controllers** (Automatic Temperatures)
Charles Engelhard, Inc.

**Crushers**
Chambers Brothers Co.
Crossley Machine Co.
Hadfield-Penfield Steel Co.
Hardinge Co.
Manufacturers Equipment Co.
Mueller Machine Co., Inc.

**Decorating Supplies**
Drakenfeld and Co., B. F.
Harshaw, Fuller and Goodwin Co.
Roessler and Hasslacher Chemical Co.
Vitro Mfg. Co.

**Disintegrators**
Chambers Brothers Co.
Crossley Machine Co.
Hadfield-Penfield Steel Co.
Manufacturers Equipment Co.
Mueller Machine Co., Inc.

**Doors** (Kiln-Dryer)
Manufacturers Equipment Co.

**Dryers** (China Ware—Porcelain)
Philadelphia Drying Machinery Co.
Proctor and Schwartz, Inc.
Russell Engineering Co.

**Dryers** (Radiated Heat)
Manufacturers Equipment Co.

**Drying Machinery**
Crossley Machine Co.
Philadelphia Drying Machinery Co.
Proctor and Schwartz, Inc.
Manufacturers Equipment Co.

**Electrical Instruments**
Charles Engelhard
Wilson-Maeulen Co.

**Electrical Porcelain Machinery**
Crossley Machine Co.
Mueller Machine Co., Inc.

**Enameling Equipment, Complete**
The Porcelain Enamel & Mfg. Co.

**Enameling Furnaces**
The Porcelain Enamel & Mfg. Co.
U. S. Smelting Furnace Co.

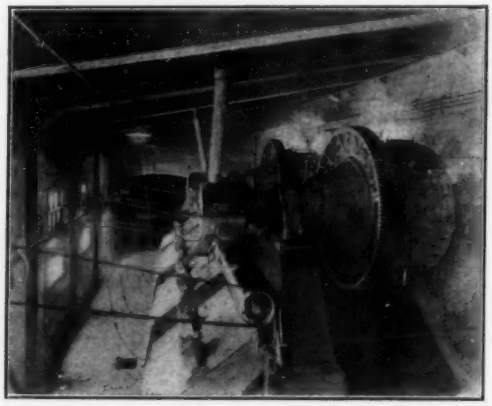
**Enameling Muffles**
Parker-Russell Mining & Mfg. Co.

**Enameling, Practical Service**
The Porcelain Enamel & Mfg. Co.

**Enamels, Porcelain**
The Porcelain Enamel & Mfg. Co.

**Engineering Service**
Crossley Machine Co.
Chambers Brothers Co.
Hadfield-Penfield Steel Co.
Manufacturers Equipment Co.

**Equipment** (used)
Nashville Industrial



# Feldspar and Flint Grinding Revolutionized

Mr. Raymond B. Ladoo, Mineral Technologist, United States Bureau of Mines, after making a thorough investigation of the methods of grinding feldspar and flint, states that grinding in these industries will be revolutionized.

The remarkable savings effected through the application of the Hardinge Conical Pebble Mill in a new way is responsible for such a statement. The operation is continuous, power is therefore cut in half, and labor to one-fifth of that required in the old style plants. The product is uniform and absolutely free of contamination.

Write for information about the system Mr. Ladoo recommends. It is the system we install.

**HARDINGE COMPANY**
**120 Broadway, New York, N. Y.**

# Hardinge Conical Mills

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Mueller Machine Co., Inc.
Philadelphia Drying Machinery Co.
Proctor and Schwartz, Inc.
Russell Engineering Co.

**Engines**
Nashville Industrial Corp.

**Extruding Machines** (Lab. Use)
Chambers Brothers Co.

**Feldspar**
Drakenfeld and Co., B. F.
Harshaw, Fuller and Goodwin Co.
O'Brien and Fowler
Old Hickory Clay & Talc Co.
Penland Feldspar & Kaolin Co.
Roessler & Hasslacher Chemical Co.

**Filtering Machinery**
Crossley Machine Co.
Mueller Machine Co., Inc.

**Fire Brick**
Parker-Russell Mining & Mfg. Co.

**Fuel**
Seaboard Fuel Corp.

**Furnaces**
Parker-Russell Mining & Mfg. Co.
The Porcelain Enamel & Mfg. Co.
The Surface Combustion Co.
U. S. Smelting Furnace Co.

**Gold**
Harshaw, Fuller and Goodwin Co.
Roessler and Hasslacher Chemical Co.

**Glazes and Enamels**
Harshaw, Fuller and Goodwin Co.
Roessler and Hasslacher Chemical Co.
Vitro Manufacturing Co.

**Ilmenite**
Buckman and Pritchard, Inc.

**Impervite** (Refractory and Hard Porcelain)
Charles Engelhard, Inc.

**Iron** (Enameling)
United Alloy Steel Corp.

**Jiggers**
Crossley Machine Co.
Hadfield-Penfield Steel Co.
Mueller Machine Co., Inc.

**Kaolin**
Edgar Plastic Kaolin Co.
Harshaw, Fuller and Goodwin Co.
Old Hickory Clay & Talc Co.
Penland Feldspar & Kaolin Co.
Roessler & Hasslacher Chemical Co.

**Kryolith**
Pennsylvania Salt Mfg. Co.

**Laboratory Equipment**
Nashville Industrial Corp.

**Laboratory Mills**
Crossley Machine Co.

**Metals** (Porcelain Enameling)
United Alloy Steel Corp.

**Mills** (*See under Ball Mills*)
(*See under Pebble Mills*)

**Minerals**
Drakenfeld and Co., B. F.
Harshaw, Fuller and Goodwin Co.
Roessler and Hasslacher Chemical Co.

**Mixing Machines**
Chambers Brothers Co.

**Muriatic Acid**
Harshaw, Fuller and Goodwin Co.
Pennsylvania Salt Mfg. Co.
Roessler and Hasslacher Chemical Co.

**Oil** (Die)
Best Oil Works

**Oil** (Lubricating)
Best Oil Works)

**Oil** (Sagger)
Best Oil Works

**Operators** (Coal)
Seaboard Fuel Corp

**Oxides**
Drakenfeld and Co., B. F.
Harshaw, Fuller and Goodwin C

Paper Makers Importing Co., (Inc.)
Pennsylvania Salt Mfg. Co.
Roessler and Hasslacher Chemical Co.

**Pans** (Wet and Dry)
Chambers Brothers Co
Crossley Machine Co
Hadfield-Penfield Steel Co,
Manufacturers Equipment Co.
Mueller Machine Co., Inc.

**Paris White**
Potters Supply Co., The

**Pebble Mills**
Crossley Machine Co.
Hadfield-Penfield Steel Co.
Hardinge Co.
Mueller Machine Co., Inc.

**Pins**
Potters Supply Co., The

**Plate Feeders**
Chambers Brothers Co.
Crossley Machine Co.
Hadfield-Penfield Steel Co.
Manufacturers Equipment Co.

**Porcelain Enameling Service, Practical**
The Porcelain Enamel & Mfg. Co.

**Porcelain Enamels**
The Porcelain Enamel & Mfg. Co.

**Pottery Machinery**
Crossley Machine Co.
Hadfield-Penfield Steel Co.
Manufacturers Equipment Co.
Mueller Machine Co., Inc.

**Producer Gas Burning Systems**
Manufacturers Equipment Co.

**Publishers** (Book)
John Wiley & Sons, Inc.

**Pug Mills**
Chambers Brothers Co.
Crossley Machine Co.
Hadfield-Penfield Steel Co.
Manufacturers Equipment Co.

**Pulverizing Machinery**
Crossley Machine Co.
Hadfield-Penfield Steel Co.
Hardinge Co.
Manufacturers Equipment Co.
Mueller Machine Co., Inc.

**Pulverizing Mills**
Crossley Machine Co.
Hadfield-Penfield Steel Co.
Hardinge Co.
Mueller Machine Co., Inc.

**Pumps**
Mueller Machine Co., Inc.

**Pyrometers** (Indicating)
Charles Engelhard, Inc
Wilson-Maeulen Co.

**Pyrometers** (Recording)
Charles Engelhard, Inc.
Wilson-Maeulen Co.

**Pyrometer Tubes** (Refractory and Hard Porcelain)
Charles Engelhard, Inc.
Montgomery Porcelain Products Co.

**Quartz**
Old Hickory Clay & Talc Co.
Penland Feldspar & Kaolin Co.

**Recording Instruments**
Charles Engelhard, Inc.

**Refractory Materials**
Buckman and Pritchard, Inc.
Parker-Russell Mining & Mfg. Co.

**Regulators** (Automatic Temperatures)
Charles Engelhard, Inc.

**Rutile**
Buckman and Pritchard, Inc.

**Sagger Presses**
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Crossley Machine Co.
Hadfield-Penfield Steel Co.
Mueller Machine Co., Inc.

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# Tunnel Kiln
(ZWERMAN PATENT)

Russell Tunnel Kilns are far beyond the experimental stage. A number are in daily operation in several industries, saving time, labor and fuel. The details will interest you. Write for them, and special catalog, "Modern Firing."

**RUSSELL ENGINEERING COMPANY**
**Railway Exchange Bldg., St. Louis, Mo.**

E-542

# ZIRCONIA

**Natural Dioxide**
**powdered——granulated**
**White Refined Dioxide**
**free from iron**

# ENAMELS IN ALL COLORS

**for Cast Iron**
**Coloring Oxides**

THE VITRO MFG. CO. TRADE MARK PITTSBURG, PA.

**and for Steel**
**Vitro White**

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**Scientific Book Publishers**
John Wiley & Sons Inc.
**Shippers (Coal)**
Seaboard Fuel Corp.
**Silica Brick**
Parker-Russell Mining & Mfg. Co.
**Silex Lining**
Hardinge Co.
**Selenite of Sodium**
Drakenfeld and Co., B. F.
Vitro Mfg. Co.
**Smelters**
Parker-Russell Mining & Mfg. Co.
The Surface Combustion Co
U. S. Smelting Furnace Co.
**Stilts**
Potters Supply Co., The
**Stoneware (Chemical)**
Nashville Industrial Corporation
**Sulphuric Acid**
Drakenfeld and Co., B. F.
Harshaw, Fuller and Goodwin Co.
Pennsylvania Salt Mfg. Co
Roessler and Hasslacher Chemical Co.
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Charles Engelhard, Inc.
**Thermometers (Electric Resistance)**
Charles Engelhard
Wilson-Maeulen Co.
**Tile Machinery (Floor and Wall)**
Crossley Machine Co.
Mueller Machine Co., Inc.
**Tubes (Insulating)**
Montgomery Porcelain Products Co.
**Tubes (Pyrometer)**
Charles Engelhard, Inc.
Montgomery Porcelain Products Co.
**Tunnel Kilns**
Russell Engineering Co
**Vacuum Pumps**
Mueller Machine Co., Inc.
**Whiting**
Drakenfeld and Co., B. F.
Harshaw, Fuller and Goodwin Co.
Roessler and Hasslacher Chemical Co.
**Zircon (Miners of)**
Buckman and Pritchard, Inc.
**Zirconia**
Vitro Mfg. Co.
**Zirconium Silicate (Fire Cement)**
Buckman and Pritchard, Inc.
**Zirconium Silicate (Refined)**
Buckman and Pritchard, Inc.

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## The "Crossley" Ball Bearing Lawn

No bronze boxes, straps or keys to cause you any trouble. Something new, worth your consideration; it will save you money and annoyance.

Write us for full information

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**Trenton** **New Jersey**

**Clay Working Machinery Specialists**

**CLAY**

**FELDSPAR FLINT KAOLIN**

Can be profitably advertised in THIS JOURNAL.

The Buyers' Guide is considered as the authoritative directory of reliable products in the Ceramic Industry, and your products, particularly the raw material, should be listed there.

When you advertise in the JOURNAL you cover the industry.

**ADDRESS**

**American Ceramic Society**

**168 Roseville Ave.** **Newark, N. J.**

## A WORD FROM THE MEMBERSHIP COMMITTEE.

**EVERY MAN in the Ceramic field owes it to himself and to the industry to be a member of THE AMERICAN CERAMIC SOCIETY.**

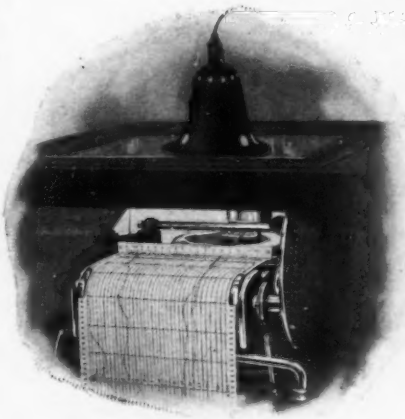
**The growth of the Society shows its increasing importance. Membership means influence and prestige for every man affiliated.**

**The circulation of the "Journal" is keeping pace with the growth of the Society and the advertising is increasing as well. Every membership received means greater possibilities in its work.**

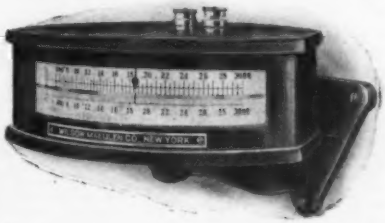
**For full information address—**

**FRANK H. RIDDLE, Chairman**
**Membership Committee**

**JEFFREY-DEWITT CO.,**
**Detroit, Michigan**



TAPALOG (Multi-Recorder)



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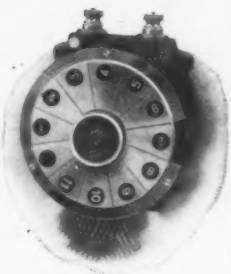

**PYROMETERS for Production or Research**

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